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THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

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VI.—FRANCE. PART II.

WHY is Belgium entitled to a separate national existence among the states of modern Europe? Ireland and even Wales have tenfold stronger claims to political independence on the score both of race and religion. One half of this little state is topographically like Holland; the other is not to be distinguished in climate, geography, or soil from Alsace-Lorraine—that shuttlecock among nations. Belgium is father to no national speech. The Flemings can not hold common converse with their fellow-countrymen, the Wallons; for the first speak a corrupted Dutch, the second an archaic French language. Nor are the people more highly individualized in the anthropological sense. In fact, in a study of races Belgium is not to be considered apart from either northern France or southwestern Germany. It is closely allied to both. Of course, even despite the lack of all these elements of nationality, there is still a reason for the separate political existence of the Belgians. There must have been, for the sense of nationality is very intense among them. There is no sign of its abatement at the present time. It has made them a dominant power in Africa and elsewhere abroad. Their nationality is a geographical as well as an historical product. We shall deal with that presently. In the meantime we must consider the Belgians together with the whole population of northern

France. It is befitting to do so; for Cæsar informs us that the Belgæ in his time controlled the whole region. Roman Gaul, properly speaking, extended only as far north as the Seine and the Marne. In Cæsar's time the frontier of Belgium—the land of the Belgæ—lay near Paris. Has its recession to the north produced any appreciable change upon the people? Certainly not in any physical sense, as we shall attempt to point out.

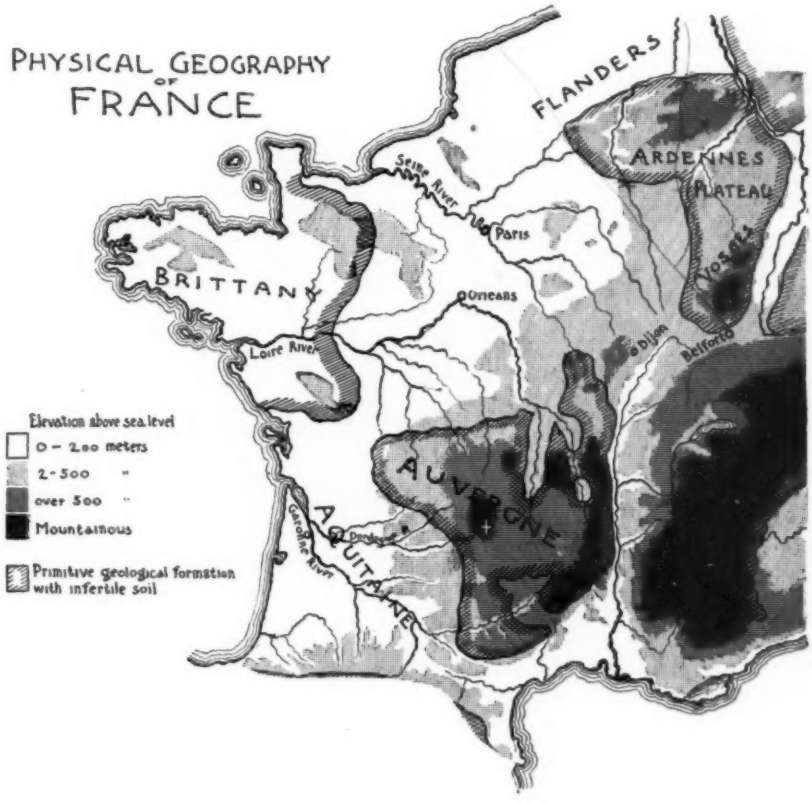
The northern third of France and half of Belgium are to-day more Teutonic than the south of Germany. This is clearly attested by the maps which show the distribution of each of the physical characteristics of race. It should not occasion surprise when we remember the incessant downpour of Teutonic tribes during the whole historic period. It was a constant procession, of Goths—from all points of the compass—of Franks, Burgundians, and others. France was entirely overrun by the Franks, with the exception of Brittany, by the middle of the sixth century. All through the middle ages this part of Europe was not only ethnically Teutonic: it was German in language and customs as well. The very name of the country is Teutonic. It has the same origin as Franconia in southern Germany. In 812 the Council of Tours, away down south, ordained that every bishop should preach both in the Romance and the Teutonic languages. The Franks preserved their German speech four hundred years after the conquest.* Charlemagne was a German; his courtiers were all Germans; he lived and governed from outside the limits of modern France. The Abbé Sieyès uttered an ethnological truism when, in the course of the French Revolution, he cried out against the French aristocracy: "Let us send them back to their German marshes whence they came!" Even to-day the current of migration between France and Germany sets strongly to the south, as it has ever done in virtue of economic laws deeper than national prejudice or hostile legislation.†

The movement of population racially has been strongly influenced by the geography of the country. Were it not for the peculiar conformation of this part of Europe, there would be no geographical excuse for the existence of Belgium as a separate

* For many details, and a map of German place names in northern France, consult that remarkable book of Canon Isaac Taylor, Names and Places, pp. 94 *seq.* It is a work which should be made familiar to every would-be teacher of history and geography.

† The standard authorities upon Belgium are E. Houzé, Ethnogénie de la Belgique, Bruxelles, 1882; and L. Vanderkindere, L'Ethnologie de la Belgique, Bruxelles, 1879. R. Böckh, in Zeits. f. allg. Erdkunde, Berlin, iii, 1854, p. 80, has mapped the linguistic boundary. *Cf.* also H. Vandenhoven, La Langue Flamande, Bruxelles, 1844. The last investigation is by K. Brämer, in Kirchhoff's Forschungen zur deut. Land- u. Volkskunde, ii, 1887, Heft 2. The boundary of the Flemish language on the south in France is mapped by R. Andrée in Globus, xxxvi, 1879, pp. 6–10 and 25–29. *Vide* also G. Lagneau, Ethnogénie des Populations du Nord de la France, Rev. d'Anth., 1874, pp. 577–612.

political entity, as we have said; and northern France would be far more thoroughly Teutonized than it is to-day. In order to make this clear, we must recall the topography of the district for a moment. From the Alps in western Switzerland a spur of mountainous country of very indifferent fertility, known as the Ardennes plateau, extends far out to the northwest, its axis lying along the Franco-German frontier, as our map of the geography of France shows. This area is triangular in shape, with its apex



touching Switzerland, the Rhine forming its eastern edge, and its base lying east and west across Belgium a little north of Brussels. This base is the geographical boundary between Flanders and the rugged uplands. Near the southern point, this Ardennes plateau rises into the Vosges Mountains. The major part of it consists of an elevated table-land, of little use in agriculture. Its uplands are heavily forested; its valleys are deep and very narrow. This plateau is divided from the main body of the Alps by a low pass about twenty-five miles wide, known as the Gap of Belfort. This has always formed the main pathway of communication between the valleys of the Seine, the Rhone, and

the Rhine, from the time of Attila to that of the Emperor William I. It is the strategic key to central Europe. The only other routes from France to Germany cut straight across the difficult Ardennes plateau, following either the valleys of the Meuse or the Moselle shown on our map. These valleys are both extremely fertile, but narrow and easy of defense. Sedan commands the one and Metz the other. This depression at Belfort has played quite a unique part in the natural history of Europe as well as in its military campaigns. It is the only route by which southern flora and fauna could penetrate to the north, since they could not traverse the Alpine highlands. The parallel is continued by the constant counter-migration of southern culture over the same way, evinced in archæology and history. It is not surprising that in anthropology this Gap of Belfort should be equally important.*

This Ardennes plateau is the core of a considerable population, which is primarily of the Alpine racial type. It is an anthropological table-land of broad-headedness, surrounded on every side except the south, where it touches the Alps, by more dolichocephalic populations. Turn for a moment to our map on page 440. Notice the wing of dark tint extending up to Luxemburg from Belfort. Observe how it is eroded on the east along the Rhine Valley, and toward Paris in the fertile plains of the Isle de France. In the recesses of the Vosges Mountains the cephalic index rises 87; in the valleys of the Meuse and the Moselle it falls to 83.† The Germanic tribes in their ceaseless wanderings are the cause of that phenomenon beyond question. It is evident that for Teutonism to enter France, it must pass through the Gap of Belfort, around north through Flanders, or follow the valleys above mentioned. All three of these it has certainly done in the anthropological sense. It has overflowed along each of these channels, traversing the Alpine racial barrier. It has done even more. Its influence is manifest even in the nooks and byways. For the people of the whole region are well above the average French in stature. They are quite Teutonic in this respect. But the invaders have not been able to efface that most persistent trait of the primitive population—the broad, round head. Here, as in the Black Forest, just across the Rhine,

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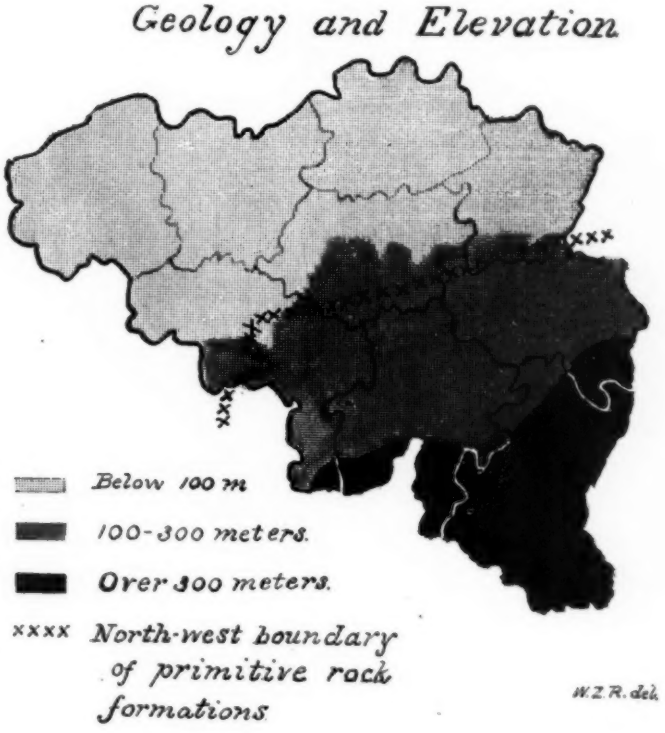
* W. Marshall, Tierverbreitung, in Kirchoff's Anleitung zur deut. Landes- u. Volksforschung, p. 256. Montelius, Verbindungen zwischen Skandinavien und dem oestlichen Europa, Archiv für Anth., 1891, pp. 1–21.

† The authority upon this region is Dr. R. Collignon. *Vide* his Anthropologie de la Lorraine, Nancy, 1886; especially, the map opposite page 9, showing the influence of the river valleys: L'Anthropologie, I, 1890, p. 211 *seq.*; and Bull. Soc. d'Anth., Paris, 1887, p. 306; ibid., 1883, p. 463. Auerbach gives a fine description of the geographical features in Revue de Geographie, Paris, 1890–'91.

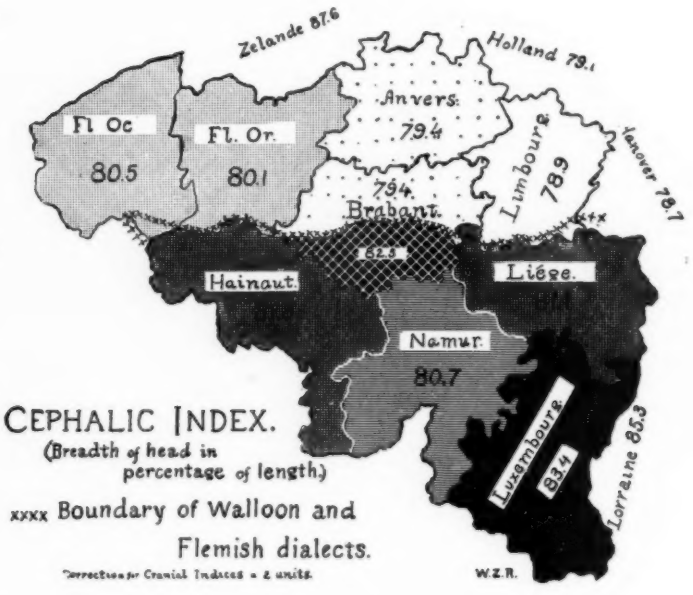
this physical characteristic remains as a witness of priority of title to the land.

In Belgium itself, lying on the northwestern edge of the Ardennes plateau, the contrast between the upland and the plain is so distinct, and it coincides so closely with the racial boundary between the Flemings and the Walloons, that it merits special attention. Language here follows closely in the footsteps

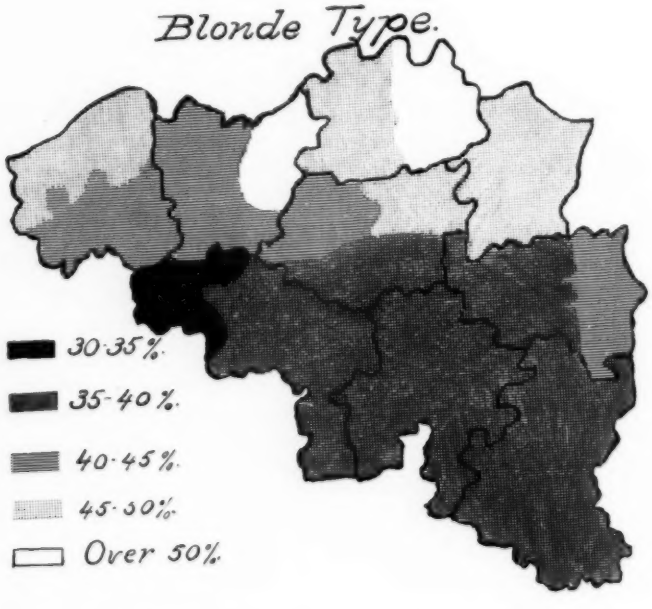


of race. As our three maps of the country show in detail, the Walloons in the uplands are broader-headed than the Flemings. They are distinctly shorter in stature.* Our map shows how much more infrequent blond types are among them than among the Flemings. It is curious to notice this Teutonism of Flanders and the Low Countries. It denotes the utter extermination of all traces of the Spaniards, despite their whilom political activities. Belgium is sharply divided, therefore, into two halves, following the topographical boundary of the plateau exactly, except in the department of Hainault, where Walloons are found in the plains. The two halves of Belgium thus indicated differ in poli-

* Quetelet long ago showed this. *Vide* Titeca, Bull. Soc. d'Anthropologie de Bruxelles, vi, 1887, p. 109. Houzé has mapped the stature in ibid., vi, 1887, p. 278.



tics, language, and in many social customs. One, Flanders, is cultivated largely by tenant farmers, the other tilled by peasant



proprietors. So clearly drawn is the line of division that many interesting sociological problems may best be investigated here. These, for the moment, we pass by. For us, at this time, the sig-

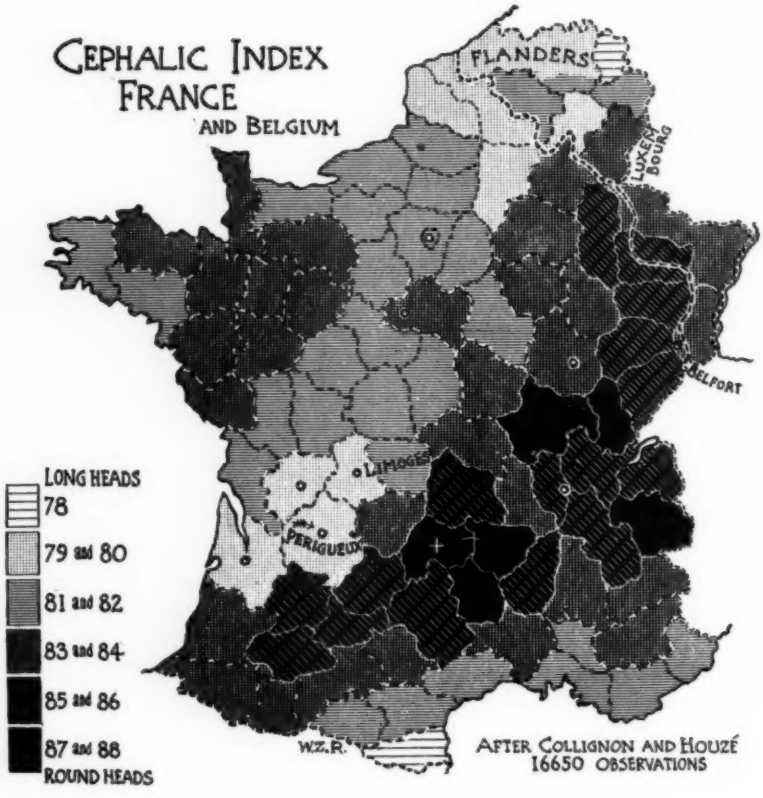
nificance of the division is, to put it in Dr. Beddoe's words, that "the Walloons and their hilly, wooded country are a Belgic cliff against which the tide of advancing Germanism has beaten with small effect, while it has swept with comparatively little resistance over the lowlands of Flanders and Alsace, and penetrated into Normandy and Lorraine." Had it not been for this geographical area of isolation, political boundaries would have been very different from those of to-day. Belgium is a piece of pie-shaped stop-gap between France and Germany. Being internationally neutralized in the military sense, it covers the main line of contact between the two powerful neighbors—the plains of Flanders. This is, in the eyes of the natural scientist, its main excuse for separate existence as a political entity. The Franco-German hatred is nothing but a family quarrel after all from our point of view. It is a reality, nevertheless, for historians. The only country whose population is really homogeneous is the tiny kingdom of Luxemburg in the very center of the plateau, scarcely more than a dot on the map. It deserves its independence for a like reason with Belgium. Were Alsace-Lorraine also a neutralized and separate kingdom, the prices of European government bonds would be considerably higher than they are to-day.

Let us now return to France again. We have still to cover the most interesting part of all in many ways. Cæsar's third division of Gaul, from the Loire River southwest to the Pyrenees, was inhabited, as he tells us, by the Aquitani. Strabo adds that these people were akin to the Iberians of Spain, both in customs and race. Detailed study, however, reveals a population far less homogeneous than these statements of the ancients imply.

A glance at the map of the physical geography of France, on page 435, shows that this southwestern section is centered in the broad, fertile valley of the Garonne. From Bordeaux in every direction spreads one of the most productive regions in France, favored alike in soil and in climate. Ascending the river valley, it narrows gradually until we reach a low pass, leading over toward the Mediterranean. This little axis of fertility, along which will run the projected canal to unite the two seacoasts of France, divides the plateaux of Auvergne from the highlands which lie along the Pyrenees. In this latter region fertility decreases as we approach the Spanish frontier in proportion to the increase in altitude, although most of the region is fairly capable of supporting a considerable population. The only extensive area which is extremely unfavorable in character is the seacoast department of Landes, along the Bay of Biscay south of Bordeaux. This region is a vast sandy plain, but little raised above the sea level. It is a flat district underlaid by an impermeable clay subsoil, which is, except

in midsummer, a great fen covered with rank marsh grasses. Without artificial drainage, it is unfit for cultivation, so that it remains to-day one of the most sparsely populated sections of the country. As a whole, then, the southwest of France presents the extremes of economic attractiveness, at the same time being devoid of those geographical barriers which elsewhere have strongly influenced the movements of races.

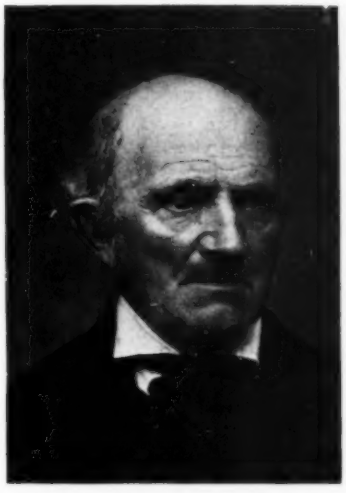
The first impression conveyed by the general map of the cephalic index for all France, in respect of this particular region above described, is that here at last all correspondence between the nature of the country and the character of the population ceases. A wedge of the broad-headed Alpine stock centering in the uplands of Auvergne pushes its way toward the southwest to



the base of the Pyrenees. This Alpine offshoot extends uninterruptedly from the sterile plateau of Auvergne, straight across the fertile plains of the Garonne and deep into the swamps and fens of Landes. While the geographical trend of the country is from southeast to northwest parallel to the Garonne, the population seems to be striped at right angles to it—namely, in the direction

of the Paris-Bordeaux axis of fertility. At the northwest appears the lower edge of the broad-headedness of the area of Brittany; then succeeds a belt of long heads from Paris to Bordeaux, to the

MEDITERRANEAN TYPE. Montpellier.
Cephalic Index, 79·6.



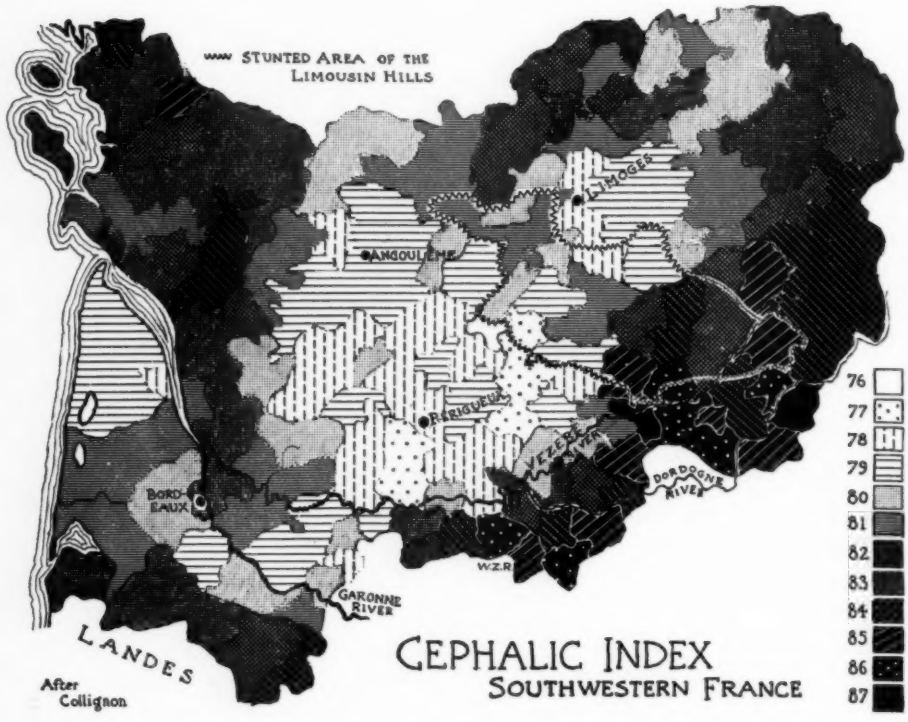
ALPINE TYPE. Aveyron.
Cephalic Index, 86.

south of which comes the main feature—a central strip of the Alpine type pushing its way to the extreme southwest, as we have said. The portrait herewith is a good example of the last-named round-headed type, which forms the bulk of the population. We are confronted by a racial distribution which appears to be utterly at variance with all the laws which elsewhere in France determine the ethnic character of its population.

One point is certain: either conditions have changed wonderfully since Strabo's time, or else the old geographer was far from being a discriminating anthropologist, when he described the people of Aquitaine as uniformly Iberians, both in race and in customs. A large element among them is as far removed from the Spaniards in race as it is possible in Europe to be. There is, as our map shows, a strip all along the Mediterranean which is Iberically narrow-headed and oval-faced, of a type illustrated in our portrait. Especially is this true in the department of Pyrénées-Orientales, shown on our map by the banded white area. This is the only part of France where the Catalan language is spoken to-day, as we took occasion to point out in our first article. This population in Roussillon is truly Iberian both in race and language; all the other peoples of Aquitaine differ from the Spaniards in both respects.*

* The prime authority upon this part of France is again Dr. Collignon. *Vide* Mém. Soc. d'Anth., Paris, series 3, i, fasc. 3 and 4. Condensed statement of his views is given in

Turn back for a moment to the map of head form on page 440, and notice the curious light-tinted area in the heart of this south western region. It seems to be confined to four departments, lying between Limoges on the northeast and Bordeaux at the south-



west. This little island or sink, if you please, of long-headedness has for years been a puzzle to anthropologists. It is a veritable outcrop of dolichocephaly close to the great body of broad-headedness which centers in Auvergne. It lies, to be sure, at the southwestern extremity of that axis of fertility from Paris to Bordeaux which we described in our last paper. In conformity with the law of differentiation of populations which holds all through the north, a long-headed people is found in the plains. The trouble is that the people are altogether too extreme. The general law is out-proved by it. The remoteness of this spot from any other great center of long-headedness constitutes the main point of interest. Such a trait ought to have been derived either from the north or the south of Europe. Teutonic intermixture is not a competent explanation for two reasons. In the first place,

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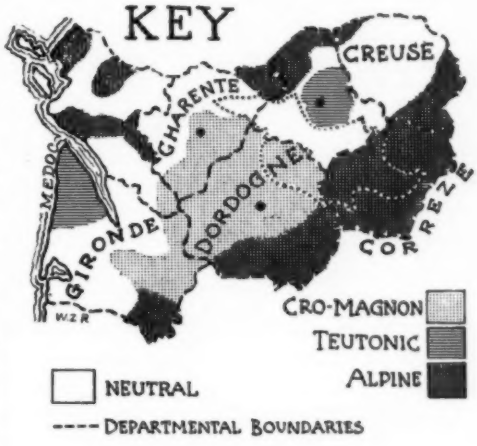
Annales de Géographie, Paris, 1896, pp. 156–166. Our maps are adapted from this latter source. G. Lagneau, Ethnogénie des Populations du Sud-ouest de la France, in Revue d'Anth., 1872, pp. 606–628, gives much interesting historical material.

the heads are often more Teutonic in form than those of the peoples of direct Germanic descent along the Belgian frontier; nay, more, in some cantons the people outdo the purest Scandinavians in this respect. This region is also separated from all Teutonic centers across country by several hundred miles of broader-headed peoples. That disposes of the theory of colonization from the north across France. Could the Teutons have come around by sea, then, following the *litus Saxonicum* described in our last paper? Obviously not so; for, as we shall see, the deepest pit of long-headedness lies far inland, about the city of Périgueux. If this be due to immigrants, they certainly could not have come in ships. Is it possible, then, that the people of these departments could have come from the south, an offshoot of the Mediterranean type? If so, they must have come over the Pyrenees or else across the low pass down the course of the Garonne. In either case a great dike of brachycephaly must have been heaped up behind them, cutting off all connection with their base of racial supplies. And then, after all, we do not place too much reliance in any case upon theories of such wholesale bodily migration that populous departments among the largest in France are completely settled in a moment. Human beings in masses do not, as my friend Major Livermore has put it, play leap-frog across the map in that way, save under great provocation or temptation. We look for slow-moving causes, not cataclysms, just as the geologists have long since learned to do.



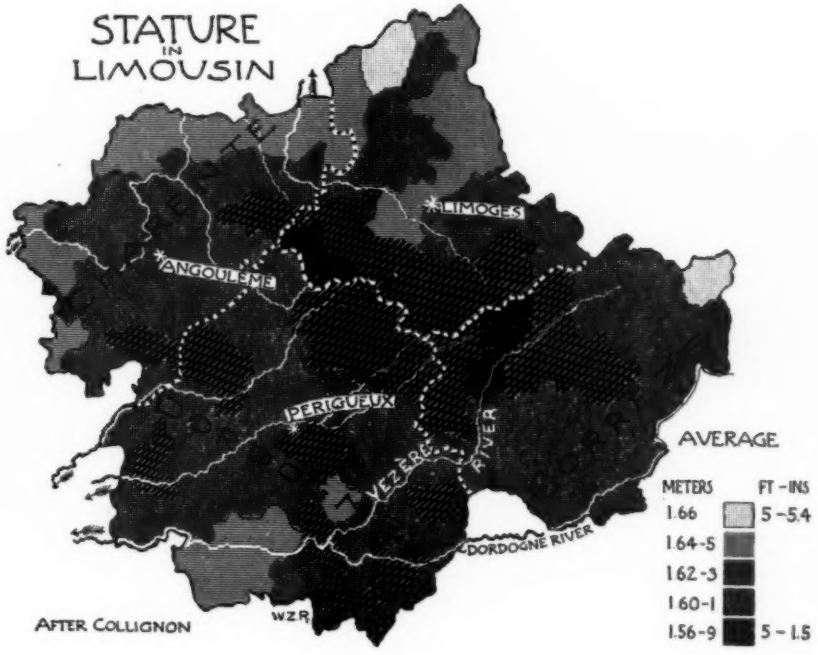
We may gain an idea of the reality of this curious phenomenon if we turn to our second map, in which the same region is charted in great detail. The head form is here given by cantons, small administrative divisions intermediate between the department and the commune or township. The location of the capital cities of Limoges and Périgueux, on both maps, will enable the reader to orient himself at once. The "key" shows the boundaries of the departments. It is clear that a series of concentric circles of increasing long-headedness—that is, of light tints upon the map—point to a specific area where an extreme human type is prevalent.

History offers no clew to the situation. The country in question, in Cæsar's time, was occupied by a number of tribes of

whose racial affinity we know nothing. On the west dwelt the Santones by the present city of Saintes (ancient Saintonge). The city of Périgueux, which gave its name to the ancient province of Périgord, marks the territory of the Petrocorii of Roman times. The province of Limousin to the northeast of it was the home of the Lemovices, with their capital at the modern city of Limoges. Around the ancient city at Bordeaux lay the Bituriges and their allies the Medulli (Médoc). Along the east lay the Arvergni, whence the name Auvergne; together with a number of minor tribes, such as the Cadurci, giving name to the district of Quercy to-day. Unless the population has shifted extensively, contrary to all ethnological experience, the people whose physical origin is so puzzling to us included the tribes of the Lemovices and especially the Petrocorii. For these two covered the main body of narrow-headedness shown upon our map, extending over two thirds of the department of Dordogne, and up into Haute-Vienne and Charente beyond the city of Angoulême. It appears as if we had to do with two tribes whose racial origin was profoundly different from that of all their neighbors. The frontier on the southeast, between the Petrocorii and the Arverni, seems to-day to have been the sharpest of all. In places there is a sudden drop of over five units in cephalic index at the boundary lines. This means a change of type almost as great as that indicated between our two portraits on a preceding page. This is especially marked at the frontiers of the two modern departments of Corrèze and Dordogne, as our "key" map shows. This racial boundary finds no parallel in distinctness elsewhere in France, save between the Bretons and Normans. In this present case, the people are distinct because the modern boundaries coincide exactly with the ancient ecclesiastical and political ones. For centuries the Arverni in Corrèze have turned their backs upon the Petrocorii in Périgord on *fête* days, market days, at the paying of taxes, or examination of conscripts. This they did as serfs in the middle ages, and they do it to-day as freemen when they go to the polls to vote. Each has looked to its capital city for all social inspiration and support. The result has been an absence of intercourse, with its attendant consequences. Artificial selection has sharpened the contrasts imposed in the first instance by differences of physical descent. It is one of those rare cases where political boundaries are competent to perpetuate and even to accentuate natural peculiarities due to race.

Let us now concentrate our attention upon these two peoples clustering about the modern cities of Périgueux and Limoges respectively—separated alike from all their neighbors by their long-headedness. Closer inspection at once reveals that each of these two cities is to-day the kernel of a distinct subcenter of

dolichocephaly; for two very light-colored areas surround each city, the two being separated by a narrow strip of darker tint upon our map. Along this latter line the cephalic index rises appreciably. Thus, for example, while only 78 about Limoges, and 76 or 77 in Dordogne, it rises on this boundary line to 80 and 81. In other words, a bridge of relative broad-headedness cuts across the map, setting apart the descendants of the Lemovices, at Limoges, from those of their contemporaries, the Petrocorii, about Périgueux. This means that we have to do with two distinct spots of long-headedness—a small one about Limoges, and a major



one extending all about Périgueux and Angoulême. There can be no doubt about this division. The boundary is a purely natural one, and deserves a moment's attention.

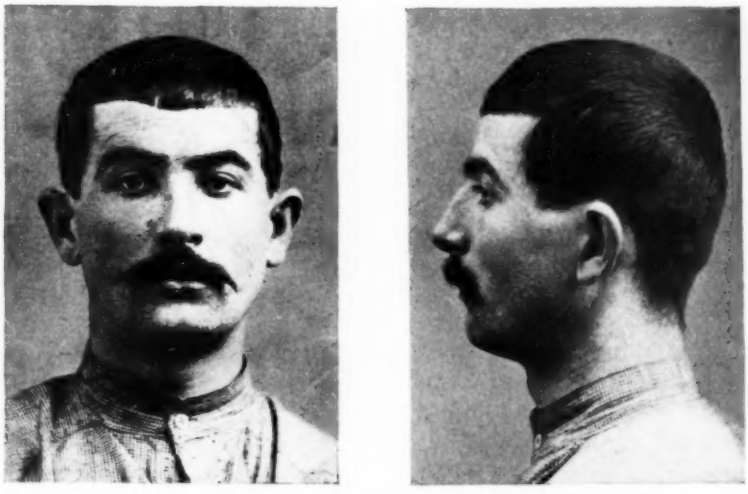
This frontier between Haute-Vienne and Dordogne lies along the crest of the so-called "hills of Limousin," made familiar to us already in another connection. It marks the watershed between the two great river systems of western France, the Garonne and the Loire. Our stature map of Limousin indicates the courses of these streams. Here is a true parting of the waters; for the Charente flows directly to the sea on the west; the affluents of the Loire run to the north; and the Vézère, part of the system of the Garonne, to the south. These hills of Limousin are the western outposts of the granitic area of Auvergne; and just here

the country changes abruptly to a calcareous formation along the south and west. The district is accounted the very poorest in all France. Its soil is worthless even for grazing; the water is bad, and the climate harsh and rigorous.

These hills of Limousin, as we pointed out in a preceding paper, are, so to speak, a veritable watershed of stature as well. The bridge of relative broad-headedness we have described as lying along this line is but one among several peculiarities. The people of these hills are among the shortest in all Europe. Imagine a community whose members are so dwarfed and stunted by misery that their average stature is only about five feet two inches! Many cantons exist in which over thirty per cent of the men are under five feet three inches tall; and a few where two thirds of them all are below this height, with nearly ten per cent shorter than four feet eleven inches. With women shorter than this by several inches, the result is frightful. Around this area we find concentric circles of increasing stature as the river courses are descended and the material prosperity of the people becomes greater. Within it the regular diet of boiled chestnuts and bad water, with a little rye or barley; the miserable huts unlighted by windows, huddled together in the deep and damp valleys; and the extreme poverty and ignorance, have produced a population in which nearly a third of the men are physically unfit for military service. This geographical barrier, potent enough to produce so degenerate a population, lies, as we have said, exactly along the boundary between the descendants of the Lemovices about Limoges and the Petrocorii about Périgueux. To make it plain beyond question, we have marked the stunted area upon our map of cephalic index. The correspondence is exact. It also shows beyond doubt that this short stature is a product of environment and not of race; for our degenerate area overlies all types of head form alike, whether Alpine or other.

Here, then, is an anthropological as well as a geographical boundary, separating our long-headed tribes from one another. Without going into details, let it suffice to say that complexions change as well. To the north and east about Limoges the blond characteristics rise to an absolute majority, especially among the women; in the contrary direction, about Périgueux, the proportion of brunettes increases considerably. In short, the general association of characteristics is such as to prove that among the Lemovices there is a considerable infusion of Teutonic blood. They are the extreme vanguard of the Germanic invaders who have come in from the northeast. That accounts at once for their long-headedness. Similar to them are the populations west of Bordeaux in Médoc (*vide* key map). They also are remnants of the same blond, tall, long-headed type; but they have come around

by sea. They are part of the Saxon hordes which have touched all along the coast of Brittany. These last people, settled in the beautiful Médoc and Bordelais wine country, protected by their peninsular position, are among the tallest peasantry of the southwest. They are, without doubt, the legitimate descendants of the Medulli and of the Nitiobriges Cubi and Vivisci of early times. But between these two colonies of the Teutons, about Limoges and in Médoc respectively, lies the one whose origin we have not yet traced. The Petrocorii about Périgueux, who were they? If they also are of Teutonic descent, why are they not blond? This they most certainly are not, for a noticeable feature of the popu-



ALPINE TYPE. Landes. Cephalic Index, 90·4.

lation of Dordogne is the high proportion of black hair, rising in some cantons to twenty-seven per cent. This is very remarkable in itself, as even in Italy and Spain really black hair is much less frequent. This characteristic for a time gave color to the theory that this great area of dolichocephaly was due to the relics of the Saracen army of Abder-Rhaman, shattered by Charles Martel at the battle of Tours. It is not improbable that some Berber blood was thereby infused into the peasantry; but this explanation does not suffice to account for other peculiarities, which a detailed investigation reveals.*

The most curious and significant trait of these long-headed people in Dordogne remains to be mentioned. A harmonic long and narrow head ought normally to be accompanied by an elongated oval visage. In the Teutonic race especially, the cheek

* G. Lagneau. On the Saracens in France. Memoirs of the Anthropological Society, London, vol. iii, pp. 157 *seq.*

bones are not prominent, so that an even smooth outline of the face results. In the Dordogne population, on the other hand, the faces in many cases are almost as broad as in the normal Alpine round-headed type. In other words, they are strongly dishar-

CRO-MAGNON TYPE. Dordogne. Cephalic Index, 78±.

monic. To make this clear, compare the two heads shown in our illustrations.* Notice at once how the Cro-Magnon head is developed posteriorly as compared with the Alpine type. This is particularly noticeable in our second portrait on the next page. Observe also how in the front view the cranium narrows at the top like a sugar loaf, at the very place where the Alpine type is most broad. Yet despite this long head, the face is proportioned much more like the broad-visaged Alpine type than after the model of the young woman's face on page 441. Hers is a truly normal and harmonic dolichocephalic type.

In our Dordogne peasant there are many other minor features which need not concern us here. The skull is very low-vaulted; the brow-ridges are prominent; the nose is well formed, and less broad at the nostrils than in the Alpine type. These, coupled with the prominent cheek bones and the powerful masseter muscles, give a peculiarly rugged cast to the countenance. It is not, however, repellent; but more often open and kindly in appearance. The men are in no wise peculiar in stature. They are of medium height, rather stocky than otherwise. In this latter respect they show the same susceptibility to environment as all their neighbors: they are tall in fertile places and stunted in the

* For the Cro-Magnon portraits on this and the following pages I am indebted to Dr. Collignon himself. These are the first, I think, ever published, either here or in Europe.

less prosperous districts. Lying mainly south of the dwarfed areas of Limousin, they are intermediate between its miserable people and their taller neighbors in the vine country about Bordeaux. Let it be clearly understood that they are not a degenerate type at all. The peasants are keen and alert; often contrasting favorably with the rather heavy-minded Alpine type about them.

The people we have described above agree in physical characteristics with but one other type of men known to anthropologists. This is the celebrated Cro-Magnon race, long ago identified by archæologists as having inhabited the southwest of Europe in prehistoric times. As early as 1858 human remains began to be discovered by Lartet and others in this region. Workmen on a railway in the valley of the Vézère, shown on our map, unearthed near the little village of Les Eyziès the complete skeletons of six individuals—three men, two women, and a child. This was the celebrated cave of Cro-Magnon. In the next few years many other similar archæological discoveries in the same neighborhood were made. A peasant in the upper Garonne Valley, near Saint-Gaudens, found a large human bone in a rabbit hole. On excavating, the remains of seventeen individuals were found

CRO-MAGNON TYPE. Dordogne. Cephalic Index, 77±.

buried together in the cave of Aurignac. At Laugerie Basse, again in the Vézère Valley, a rich find was made. In the cave of Baumes-Chaudes, just across in Lozère, thirty-five human crania with portions of skeletons were unearthed. These were the classical discoveries; the evidence of their remains has been completely verified since then from all over Europe. In no district, however, are the relics of this type so plentiful as here in Dor-

dogne. Eight sepulchral caves have been discovered within as many miles of the village of Les Eyziès alone in the Vézère valley. Because of this geographical concentration of a peculiar type in this region, it has become known by the name of the Cro-Magnon race, since in the cave of this name the most perfect specimens were found.

The geographical evidence that here in Dordogne we have to do with the real Cro-Magnon race is fully sustained by a comparison of the physical characteristics of the crania here discovered in these caves in the valley of the Vézère with the peculiar living type we have above described. The original Cro-Magnon race was extremely dolichocephalic; as long-headed, in fact, as the modern African negroes or the Australians.* The cranial indices varied from 70 to 73, corresponding to a cephalic index on the living head between 72 and 75. This was and is the starting point for the theory that the Mediterranean populations are an offshoot and development from the African negro. The only other part of Europe where so low an index has been located in the living population is in Corsica, where it descends almost to this level. The people of Dordogne do not to-day range quite as long-headed as this, the average for the extreme commune of Champagnac being 76. This difference need not concern us, however, for within the whole population are a large proportion with indexes far below this figure. Close proximity to the very brachycephalic Alpine type, just over the line in Corrèze, would account for a great deal larger difference even than this. Probability of direct descent becomes almost certainty when we add that the Cro-Magnon head was strongly disharmonic, and very low-skulled. The modern population does not equal its progenitors in this last respect, but it approaches it so distinctly as to show a former tendency in this direction. The skull was elongated at the back in the same way—a distinguishing trait which appears prominently upon comparison of the profile view of a modern Cro-Magnon type with that of its Alpine neighbors, as we have already observed. The brows were strongly developed, the eye orbits were low, the chin prominent. The noted anthropologist, De Quatrefages, prophesied what one of these types ought to look like in the flesh. I give his description in his own words, that its agreement with the facial type above represented may be noted: "The eye depressed beneath the orbital vault; the

* Quatrefages and Hamy, Crania Ethnica, p. 46 *seq.* See also Quatrefages, The Human Species, in Appletons' International Scientific Series. The best collection of material in small compass, with references, is given by Salmon in Revue Mensuelle de l'École d' Anthropologie, V, 1895, pp. 155 and 214 *seq.* Bertrand, in La Gaule avant les Gaulois, Paris, 1891, has mapped these finds of the reindeer period. The correspondence with our modern population is very close.

nose straight rather than arched, the lips somewhat thick, the maxillary (jaw and cheek) bones strongly developed, the complexion very brown, the hair very dark and growing low on the forehead—a whole which, without being attractive, was in no way repulsive."*

The prehistoric antiquity of the Cro-Magnon type in this region is attested in two distinct ways. In the first place, the people possessed no knowledge of the metals; they were in the same stage of culture as, perhaps even lower than, the American aborigines at the coming of Columbus. Their implements were fashioned entirely of stone, although it was often cunningly chipped and even polished. They were ignorant of the arts, either of agriculture or the domestication of animals, in both of which they were far below the culture of the native tribes of Africa at the present day. Additional proof of their antiquity was offered by the animal remains found intermingled with the human bones. The climate must have been very different from that of the present, for many of the fauna then living in the region, such as the reindeer, are now confined to the cold regions of northern Europe. To be sure, the great mammals, such as the mammoth, mastodon, the cave bear, and hyena, had already become extinct. They were contemporaneous with a still more ancient and uncultured type of man, whose remains occur in a lower geological stratum. This Cro-Magnon race is not of glacial antiquity, yet the distribution of mammals was markedly different from that of to-day. Thus of nineteen species found in the Cro-Magnon cave, ten no longer existed in southern Europe. They had migrated with the change of climate toward the north. The men alone seem to have remained in or near their early settlements, through all the changes of time and the vicissitudes of history. It is perhaps the most striking instance known of a persistency of population unchanged through thousands of years.

It should not be understood that this Cro-Magnon type was originally restricted to this little region alone. Its geographical extension was once very wide.† The classical skull of Engis, in Belgium, so well described by Huxley in Man's Place in Nature, was of this type. It has been located in places all the way from Tagolsheim and Bollwiller in Alsace to the Atlantic on the west. Ranke asserts that it occurs to-day in the hills of Thuringia, and was a prevalent type there in the past. Its extension to the south and west was equally wide. It was the type common among the extinct Guanches of the Canary Islands. Dr. Collignon has iden-

* For description of modern representatives of this type, *vide* Quatrefages, in Bulletins Société d'Anthropologie, 1876, pp. 408–417.

† Dr. Verneau. La Race Cro-Magnon, in Revue d'Anthropologie, 1886, p. 10 *seq.*

tified it in northern Africa. From all these places it has now disappeared more or less completely. Only in two or three other localities does it still form an appreciable element in the living population. There is one outcrop of it in a small spot in Landes, farther to the southwest, and another away up in Brittany, in that peculiar population at Lannion which we left in our last article with a promise to return to it. On the island of Oloron off the west coast there seems to be a third survival. A very ancient type has also been described by Virchow in the islands off northern Holland, which is quite likely of similar descent.

In all these cases of survival above mentioned, geographical isolation readily accounts for the phenomenon. Is that also a competent explanation for this clearest case of all in our population in Dordogne? Why should these peasants be of such direct prehistoric descent as to put every ruling house in Europe to shame? Has the population persisted simply by virtue of numbers, this having been the main center of its dispersion in prehistoric times? Or is it because of peculiarly favorable circumstances of environment? It certainly is not due to isolation alone, for this region has been overrun with all sorts of invaders, during historic times at least, from the Romans to the Saracens and the English. Nor is it due to economic unattractiveness; for, be it firmly fixed in mind, the Cro-Magnon type is not localized in the sterile Limousin hills, with their miserable stunted population. It is found to-day just to the southwest of them in a fairly open, fertile country, especially in the vicinity of Bordeaux. These peasants are not degenerate; they are, in fact, of goodly height, as indeed they should be to conform to the Cro-Magnon type. In order to determine the particular cause of this persistence of an ancient race, we must broaden our horizon once more, after this detailed analysis of Dordogne, and consider the whole southwest from the Mediterranean to Brittany as a unit. It is not impossible that the explanation for the peculiar anomalies in the distribution of the Alpine stock hereabouts may at the same time offer a clew to the problem of the Cro-Magnon type beside it.

The main question before us, postponed until the conclusion of our study of the Dordogne population, is this: Why has the Alpine race in the southwest of France, in direct opposition to the rule for all the rest of Gaul, spread itself out in such a peculiar way clear across the Garonne Valley and up to the Pyrenees? It lies at right angles with the river valley instead of along it. In other words, why is not the Alpine type isolated in the unattractive area of Auvergne instead of overflowing the fertile plains of Aquitaine? The answer is, I think, simple. Here in this uttermost part of France is a last outlet for expansion of the Alpine race repressed on every side by an aggressive alien population.

It has merely expanded along the line of least resistance. The Alpine type in Auvergne, increasing in numbers faster than the meager means of support offered by Nature, has by force of numbers pushed its way irresistibly out across Aquitaine, crowding its former possessors to one side. Certainly this is true in the Pyrenees, for here at the base of the mountains the population changes suddenly, as we shall see in our next paper on the Basques. On the other side at the north lies, as we have just seen, a second primitive population, less changed from the prehistoric type than any other in Europe. This Cro-Magnon race has been preserved apparently by the dike of the Limousin hills with their miserable population; for these hills have cut across the Paris-Bordeaux axis of fertility and have stopped the Teutonic race at the city of Limoges from expanding farther in this direction—that is to say, economic attraction having come to an end, immigration ceased with it. The intrusive Teutonic race has therefore been debarred from this main avenue of approach by land into Aquitaine. The competition has been narrowed down to the Alpine and Cro-Magnon types alone. Hence the former, overflowing its source in Auvergne, has spread in a generally southwestern direction with slight opposition. It could not extend itself to the southeast, for the Mediterranean type was strongly intrenched along the sea coast, and was in fact pushing its way over the low pass into Aquitaine from that direction. The case is not dissimilar to that of Burgundy, for in both instances a bridge of Alpine broad-headedness cuts straight across a river valley open to a narrow-headed invasion at both ends. It is not improbable that in both this bridge is a last remnant of broad-headedness which would have covered the whole valley had it not been invaded from both sides by other competitors.

Enough has been said to show the complexity of the racial relations hereabouts. We have identified the oldest living race in this part of the world. The most primitive language in Europe—the Basque—is spoken near by. It will form the subject of the next paper.

In his journeyings in the Zambesi country, Africa, Captain A. St. H. Gibbons found an ancient and interesting custom prevailing at Nalolo of investing the eldest surviving sister of the ruling king with the prerogatives of a queen, without whose advice and sanction her brother can not give effect to any important measure in the government of the state. In minor local matters she in her own district reigns supreme, holds the power of life and death over her subjects, and is at liberty to wed or depose a husband at will. The present *Makwai*, or queen, from whom six husbands have been removed in ways not natural, is described by the author as having a mixed character, being unscrupulous and very polite.

NEW QUESTIONS IN MEDICAL JURISPRUDENCE.

By T. D. CROTHERS, M. D.

THE startling revelations in the scientific world are repeated in some degree in the sudden opening up of a new territory of medico-legal science, the jurisprudence of inebriety. Within five years the question of the mental soundness of the inebriate and his capacity to act or reason normally has been raised with increasing frequency in a great variety of criminal and civil cases. The rapid advances in psychological studies fully sustain the wisdom and necessity of scientific inquiry in this field. The medical profession has been suddenly called to determine facts and their meaning, and give advice along this new line of inquiry, without precedent, and opposed by public opinion and deep-rooted prejudice, and hence are often plunged into great doubt and confusion. As a result, the strangest theories prevail as to what inebriety is and is not, theories of moral and legal accountability and responsibility, that presuppose a degree of psychological knowledge that can only be obtained after centuries of further study.

To-day there are hundreds of persons awaiting trial or sentence for crime committed when poisoned by alcohol. There are hundreds of business contracts disputed and contested by law, made when the parties were intoxicated. There are hundreds of wills whose validity is questioned for the same reason. There are hundreds of divorce suits where the inebriety of the parties is the vital question on which the issue of the case turns.

Although these topics have so recently come into medico-legal notice, and are so complicated with theories and superstitions, yet they have already divided into three distinct theories or points of view:

First, the *ethical* and *moral* view, which seeks an explanation of inebriety from the teaching of Scripture and the opinions of theologians and metaphysicians. This view asserts that inebriety is only a phase of moral depravity innate in every life, and one that is susceptible of great growth and development, by willful neglect and gratification of all the animal instincts. Medico-legally the remedy is severe punishment, increased responsibility, prayer, conversion, and the application of moral suasion.

The *second* is the *legal* view, which is practically an outcome or result of the moral theory. It assumes that inebriety is a phase of savagery or the inborn tendency to lawlessness and giving up of all control and restraint; or the indulgence of the lower passions regardless of society, law, and order. The legal remedy is severe punishment, increased penalties, and suffering.

The theory is to develop the higher nature of man by causing pain and suffering in the lower nature; in this way to rouse up the brain and will power to regain control of the animal part. Three hundred years ago Lord Coke, of England, held that inebriety always aggravated the offense, and the punishment should rather be increased. This has been the corner-stone of the legal view of inebriety up to very recent times.

The third theory is the scientific and medical view. This affirms inebriety to be a physical condition, the tendency of which is often inherited and also acquired; that this physical condition is always a disease, a modified or pronounced form of insanity. In other cases it is a positive symptom of insanity; also, it is a form of brain degeneration that, like other diseases, has distinct causes, development, progress, and decline. It is also urged that the continuous use of alcohol always causes disturbances of brain circulation, and is followed by brain congestion, brain paralysis, and impaired senses; the result of which is incapacity to realize the nature and character of acts, the judgment is defective, and the control is lessened and is not normal. Medico-legally this theory regards the inebriate as diseased and incapacitated to act sanely, to be treated as a sick man and placed under medical and legal care and control, until recovery or for life.

The first two theories assume perfect sanity in all cases of inebriety, and assert that the remedy is to be more severe punishment, and accountability to law and society. The third theory recognizes a physical condition, and demands a scientific study of each case before the remedy or treatment can be determined. Another theory has been asserted, that in some cases inebriety was a vice at first, then later a disease; that in some cases punishment is the remedy, and in others medical care and treatment. Such are some of the theories and standpoints from which the subject of inebriety is approached medico-legally.

The confusion and doubt of the exact nature of inebriety is due in a large part to the failure to study these cases independently. The dictum of judges, the teachings of theologians, newspaper views, and public opinion, are too often the sources from which medical men derive their views. This was very apparent in a contested will case, where five medical men testified to the mental capacity of a chronic inebriate who willed his property to a mistress. The judge declared he should act on his own judgment, and decide the man unsound and incapable. A man set fire to a church without apparent motive. Three physicians swore to his sanity, although he had delirium tremens repeatedly and was a chronic inebriate, and intoxicated at the time. The jury decided otherwise.

Questions involving the capacity or incapacity of inebriates can never be determined by any metaphysical theory of mind or morals.

One of the very obscure questions which have recently come into legal prominence has been called the alcoholic trance state. The frequent statement of prisoners in court, that they did not remember anything about the crime they are accused of, appears from scientific study to be a psychological fact.

It is well known to students of mental science that in certain unknown brain states memory is palsied, and fails to note the events of life and surroundings. Like the somnambulist, the person may seem to realize his surroundings and be conscious of his acts, and later be unable to recall anything which has happened. These blanks of memory occur in many disordered states of the brain and body, but are usually of such short duration as not to attract attention. Sometimes events that occur in this state may be recalled afterward, but usually they are total blanks. The most marked blanks of memory have been noticed in cases of epilepsy and inebriety. When they occur in the latter they are called *alcoholic trances*, and are always associated with excessive use of spirits. Such cases are noted in persons who use spirits continuously, and who go about acting and talking sanely although giving some evidence of brain failure, yet seem to realize their condition and surroundings. Some time after, they wake up and deny all recollection of acts or events for a certain period in the past. This period to them begins at a certain point and ends hours or days after, the interval of which is a total blank, like that of unconscious sleep. Memory and certain brain functions are suspended at this time, while the other brain activities go on as usual.

Probably the largest number of criminal inebriates who claim loss of memory as a defense for their acts are the alcoholic dements. These are chronic inebriates who have used spirits to excess for years. This, with bad training in early life, bad surroundings, and bad nutrition, have made them of necessity unsound, suffering from many and complex brain defects. Such persons are always more or less without consciousness or realization of their acts. They act automatically, only governed by the lowest and most transient impulses. Crimes of all kinds are generally accidents growing out of the surroundings, without premeditation or plan. They are incapable of sane reasoning or appreciation of the results of their conduct. The crime is unreasoning, and general indifference marks all their acts afterward. The crime is along lines of previous conduct, and seldom strange or unusual. The claim of no memory in such cases has always a reasonable basis of truth in the physical conditions of the person.

The second group of criminals who claim no memory are those where the crime is unusual, extraordinary, and unforeseen. In such cases the trance condition may have been present for some time before and escaped any special notice, except the mere statement of the person that he could not recollect his acts. The unusual nature of the crime, committed by persons who never before by act or thought gave any indication of it, is always a factor sustaining the claim of no memory. The explosive, unreasoning character of crime always points to mental unsoundness and incapacity of control.

A third group of criminals urge this statement of no memory. They are positive inebriates, drinking to excess, but not to stupor, who suddenly commit crime with the most idiotic coolness and indifference, never manifesting the slightest appreciation of the act as wrong, or likely to be followed by punishment. Crime committed is never concealed, and the criminal's after conduct and appearance give no intimation that he is aware of what he has done. These cases have been termed moral paralytics, and the claim of the trance state may be true.

A fourth group of cases where memory is claimed to be absent occurs in dipsomaniacs and periodical inebriates, who have distinct free intervals of sobriety. This class begin to drink to great excess at once, then drink less for a day or more, and begin as violently as ever again. In this short interval of moderate drinking some crime is committed of which they claim not to have any recollection.

Other cases have been noted where a condition of mental irritation or depression preceded the drink explosion, and the crime was committed during this premonitory period and before they drank to excess. The strong probability of trance at this period is sustained by the epileptic character of such conduct afterward. The trance state may be justly termed a species of *aura*, or brain paralysis, which precedes the explosion.

In some instances, before the drink storm comes on, the person's mind would be filled with the most intense suspicions, fears, delusions, and exhibit a degree of irritation and perturbation unusual and unaccountable. Intense excitement or depression, from no apparent cause, prevails, and during this period some crime may be committed; then comes the drink paroxysm, and later all the past is a blank. In these groups the crime is generally automatic, or committed in a manner different from other similar crimes. Some governing center has suspended, and all sorts of impulses may merge into acts at any moment. The consciousness of such acts and their consequences is practically destroyed.

One of the questions which has become prominent recently in

many cases is as follows: How far can the testimony of inebriates or persons under the influence of spirits be trusted concerning matters observed in this condition?

This question called for an answer in the following cases:

1. An inebriate physician, partially intoxicated, witnessed an assault, and swore to the identity and exact part which the accused was supposed to have taken in the crime.

2. A barkeeper, partially intoxicated at the time, swore to the particular man who shot another in a crowd, where several shots were fired by different persons.

3. A man under the influence of spirits testified that he saw the person accused put fire to a building which was burned down.

4. A man on his way home from a saloon, where he had spent the evening drinking, identified a man in the courtroom whom he asserted he had seen breaking into a house.

In these cases the medical witness was asked, What, in your opinion, as an expert, based on the statements of the witness, and the circumstances of the case, was the condition of the witness's mind as to the power of clearly observing and remembering the facts and incidents to which he has testified? Also, do you believe in these cases that the witness was competent to observe and clearly remember the incidents to which he has sworn?

If the medical expert has formed no higher opinion of inebriety than that it is a vice in the moral sense, and alcohol produces a state of exhilaration, his answer will be unsatisfactory; but if he is a scientific student he will form a general conclusion which will at least approximate very near to the real facts. In arriving at the facts the medical witness must start from some general principles which are recognized as established beyond question.

First, the action of alcohol is always that of an anæsthetic, benumbing and paralyzing (1) the nerve function and the consciousness of nerve impression; (2) the power of co-ordinating and regulating these impressions; (3) the reasoning or capacity of comparing acts and events is disturbed. Thus both the sense impressions and the power of analyzing and correctly estimating them are impaired. This takes place in all cases, depending on the amount and quality of spirits taken: where intoxication follows, these effects are very clear; but where a smaller amount of spirits is taken, and only partial intoxication is present, they are not so prominent. It is present in those who use alcohol continuously, and is noted as a general diminution of brain and sense acuteness. In active life, brain workers, trained experts, and all persons whose work requires delicate nerve adjustment and accuracy of brain and muscle work, soon find the use of alcohol im-

pairing their powers, and abandon its use, especially when they are called to do any particular work. The musician, the actor, the scientist, and the professional and business man very quickly discover the impairments which follow from the use of alcohol, not only over the senses, the volition, the nerve and muscle co-ordination, but the power of clearly realizing the relation of events. The increased action of the heart from alcohol is of short duration, and is surely followed by diminished sensibility and anæsthesia.

The vigor and strength supposed to come from alcohol quickly merge into weakness and debility. Hence, the man who is visibly poisoned by alcohol, however slight the degree, has defective senses, defective nerve impressions, defective co-ordination, and defective reasoning. He is literally suffering from the first stages of paralysis, which begins with the senses. He can neither see nor discriminate accurately; he is always open to the possibility of false impressions and false conclusions, and is unable to correct them. His senses may be but little impaired, but his power of comparison, of analyzing events and their meaning, is faulty. He has anæsthesia of the higher brain centers, which does not appear except from close observation.

From these general facts the study of the individual case resolves itself into a question of how far the person used spirits, and how much he had drank at or about a certain specified time; also the circumstances, conditions, and surroundings of the act in question, and the statement of the man; from this a medical witness can draw accurate conclusions.

In the two murder cases referred to, other testimony made the statement of the drinking witness doubtful. In the third case a clear alibi was established by the accused. In the other cases, although the evidence of the witness was accepted, there was a strong probability of mistake. The conclusion, which appears to be sustained by all the facts and scientific study of these cases, is as follows:

The testimony of persons while under the influence of spirits, concerning matters observed by them, and their judgment as to events and their meaning, are never accurate, but always open to sources of error and unconsious self-deception which they are unable to correct.

The medical expert should have no hesitation in denying the value and truthfulness of all such testimony.

A second question which has come up recently along this same line of research is more difficult and requires more accurate psychological and physiological study.

It is this: How far are the statements or confessions of persons partially intoxicated, or under the influence of spirits, concerning their personal acts to be accepted as true and veritable?

An answer to this question was sought in the following cases:

First. An inebriate shot and killed his partner while under the influence of spirits. At the station house, soon after, he made a confession, which reflected very severely on him. On the trial the statement of the crime was not sustained, but contradicted in many ways.

Second. A man was found drowned, and a drinking friend confessed to have pushed him into the water while in a state of intoxication. This confession was clear in its details, and he seemed very earnest and contrite. It was accepted as true, and he was sentenced to prison for life. Subsequently it was found that the drowning was accidental, and the confessed murderer was miles away sleeping at this time, suffering from alcoholic stupor. A few hours later he came to the scene of the drowning, and at once came to the conclusion that he had committed the crime.

A *third* case was that of a man who, after drinking all the evening in a saloon, saw on his way home after midnight a deadly encounter with a burglar in the hall of a house he was passing. He was taken to the station house and, after a series of questioning, identified the burglar, and swore to many details of the crime. This was found to be untrue, although he adhered very closely to the details and urged their truthfulness. In reality he had been told what he saw by the officer, whose suggestive questions made up the entire statement.

The medical questions in these cases were answered from the assumption that the use of alcohol, unless to stupor, does not impair the senses and reason on matters that concern the personal acts and conduct. It was assumed that any statements or confessions of crime that did not peril the freedom and safety of the man could have no other motive except that of the promptings of a wounded consciousness to repair the injury. It was assumed that no man under the influence of spirits, not stupidly intoxicated, would ever confess to acts not committed, or ever delude himself with such impressions, especially as at this time the brain was in a state of increased activity. All these assumptions were wrong, and contradicted by the facts. The man under the influence of spirits is always semiparalyzed; his brain is in a confused state, and never guided or controlled by natural, healthy motives; his senses and judgment are weakened, and the repetition of any statement which may impress him may soon seem a reality which he is never able to correct. His mind is open to all sorts of morbid impressions which quickly appear like realities.

In the lower courts these special phases of brain palsies are seen in the confessions and sworn statements of acts and events observed that are often found to be absolutely false. The conclu-

sion is evident that no testimony, statement, or confession of a person under the influence of spirits concerning his acts, conduct, or motives has any value or can be trusted unless sustained by collateral and other evidence.

A third question along this line of inquiry has also become prominent during the year: How far shall an inebriate, or man under the influence of spirits, be held liable for any acts or contracts, such as wills, marriages, or bargains?

The questions the medical man is asked are these: How far is the person in this state capable of appreciating the nature and consequences of his acts? Was his mind in any way impaired to that extent as to be unable to clearly realize his duty and obligations to himself and others? Was the act sane in its execution and reasonable consequences? These questions came up for an answer in the following cases: An inebriate who had drank at intervals for twenty years had made a will disposing of a large property, and had repeatedly mentioned its terms with pleasure and satisfaction. At his death it was found that he had made another will giving most of his property to the Freedman's Bureau for the education of colored children. He had been a very miserly man all his life, and this was an unusual act. The will was made after a drink period, and he seemed to the lawyer and witnesses sober and fully conscious of what he was doing. The medical men held that the use of spirits had not weakened his mind or rendered him incompetent to dispose of his property.

In a *second* case, a man who drank to excess at intervals bought a large interest in a traveling circus while under the influence of spirits. He seemed perfectly sane at the time, yet the act was unusual, and he sought to annul the contract, claiming that he was subject to undue influence.

The testimony of medical men as to the probable state of the mind when these acts were performed is the central evidence upon which the issue of each case must turn. The necessity of thorough scientific study of the mental condition of men who use spirits at intervals or continuously, and the application of all the facts that enter into the history of the cases in question, is imperative.

The question of premeditation in the drink paroxysms is a subject of much confusion in many cases.

The frequent instances where inebriates, in apparent possession of good judgment, go away and drink to great excess, displaying a degree of forethought and premeditation fully characteristic of all the ordinary events of life, are often very confusing to the ordinary observer. When the drink paroxysm comes all unexpectedly upon the victim, in some unforeseen state and circumstance, and he falls, it is apparent that he is suffering from

some unstable or diseased brain state, which has burst out from the application of some exciting cause. But when the paroxysm is anticipated and prepared for, and all the surroundings are made subservient to this end, when every facility to procure spirits is increased, when money is secured and business arrangements are made in view of this coming paroxysm, the conclusion most commonly reached by all non-expert observers is that it is deliberate vice and wickedness. When the history of a number of these cases is studied and compared, they are found to be well-marked cases of reasoning insanity, with drink paroxysms. These paroxysms are the acute attacks—the deliriums which expend themselves like storms that gather and burst—and are preceded by long periods of rest.

Several very noted cases of capital crime by inebriates have brought out this fact of premeditation, with conviction, on the theory that disease and insanity were incompatible with power of conceiving and coolly executing crime. This theory is opposed by the facts in the history of the following case: A business man, who had drank at intervals to excess for ten years, had a preliminary period of moderate drinking before the stupor or the delirium of the paroxysm of drink. During this time he continued his business as usual, but to his confidential friends he explained various schemes of revenge, in which he wished to punish persons who had injured him in business. These plans were skillfully and shrewdly arranged, and indicated a clear, unusual conception of causes and effects. The reasons for these acts were delusional, and based on strained inferences. His friends advised delay, and after the drink paroxysm his recollections of these plans became indistinct, and his interest passed away. He treated them as crazy notions, and was ashamed to consider or talk about them. These delusions only appeared when he began to use spirits, and were concealed and only mentioned to his most intimate friends. This scheme of revenge comprised arson and murder, and the execution required a combination of studied acts that would mislead and mystify others. With but little encouragement he would have committed this crime, and premeditation and malice could have been clearly brought out in the trial.

In a second case a periodical inebriate, whose preliminary period lasted from two to three weeks, planned a bank swindle. At about the time of its consummation he drank to great excess, having the usual paroxysm, then recovered and denied all knowledge of this event. While the act was very unusual and opposed to all his previous conduct and character, yet during the time it was planned he appeared to be very clear and fully conscious of the nature and character of the act. The probability is that all acute reasoning and display of full consciousness of the act

and its consequences are based on delusions, either concealed or openly confessed. The action of alcohol seems to suspend some governing center, and capacity to discriminate the folly of the act. The mind appears to be eclipsed, and previous standards of truth and honor are overshadowed. All the former vigor remains, or appears to be intact; judgment and reason display vigor and clearness in criminal acts and conduct. Motives and purposes of life have changed, although the form and semblance of the past conduct remain.

Innumerable illustrations are seen among petty criminals, so called, where the acts have preceded the drink craze, and always been executed while the victim was using spirits in small quantities. Premeditation, acute reasoning, and apparent consciousness of acts and their consequences, preceding a drink excess, either associated with a moderate use of spirits or immediately before spirits are used in excess, should always be regarded as symptoms of mental derangement.

The use of spirits for the purpose of committing crime is another disputed question in courts.

Crimes which are supposed to have been committed by persons who deliberately used spirits for this special purpose are commonly found to have been stimulated and provoked by other causes. To give spirits to a person and encourage him to commit crime may not be an unusual occurrence, but its consummation is an accident and exceedingly uncertain. On general principles the natural tendency of an inebriate's mind is to ignore all restraint and obligation, legal, social, and moral. The higher governing centers are depressed and more or less paralyzed. The senses are deranged, and false impressions are constantly received, and the power of analysis and reason is diminished and broken up. All higher relations of duty are obscured, and only the lowest, most transient impulses control the mind. At this time temptations to acts that are criminal, urged on the bewildered mind, may be acted upon, from simple incapacity to reason and understand the consequences. This blurred mental state is of short duration, and merges quickly into anæsthetic physical and mental states, or delusional conceptions, of which fear and suspicion are prominent. The use of spirits to give courage to commit crime very often produces the opposite effect, particularly where an interval occurs between the use of spirits and the performance of the act.

The courage or stimulation of the first stage from the action of alcohol on the brain is of short, uncertain duration, and liable any moment to change to abject fear or other states.

There are two conditions in which crime is committed by persons who drink spirits for this purpose: one, where they become

the agents of others, and accept and carry out the plans arranged for them, either tacitly as by power of compulsion of an idea, or desire to please another; secondly, the act is the materialization of a delusion which has existed before and has been stimulated into activity by the use of spirits. In the first case some hypnotic state, in which an idea becomes dominant, exists. But this is very unstable, and while it may be increased by alcohol, is uncertain in duration, and liable to change any moment. Thus in a case where a man who, after using spirits, developed delusions of suspicion that his partner was robbing him, this was increased by giving him more spirits and reiterating the idea, and suggesting criminal revenge. It was noticed that there was a certain brief period when he might execute a criminal act, but before and after it was very doubtful. The brain could not be depended upon: it might act in an entirely different way and from a different motive apparently. Alcohol clearly predisposes to criminality by lowering and paralyzing the higher brain centers which preside over consciousness of right and wrong. The immediate effect of spirits is to cause impulsive, petty acts. For the present moment such acts might materialize into serious crime, but it would depend upon favorable conditions and surroundings. The unstable condition of the brain made so by alcohol, is more or less incapable of sustaining a preconceived idea and carrying it out, especially if time and continuous drinking follow. This is the rule to which there are exceptions, but these exceptions clearly follow certain circumstances which are easily traced. Often it is claimed that spirits are given for the purpose of obtaining undue influence in the making of a will or signing a contract. This is confirmed by a clinical study of cases, and facts indicate the impulsiveness of the act, with absence of deliberation or forethought. Delusions and misconceptions of acts and motives are very common in all inebriates. Faulty reasoning, childish credulity, and general failure of capacity to discriminate and adjust himself to the conditions and surroundings, must of necessity result in wrongdoing; although in many cases this condition is covered up, and only when the person acts along unusual lines is it apparent.

All contracts and wills written by inebriates should be subjected to careful scrutiny. Not infrequently such acts display sound judgment, and it is found that they are the culmination of previous conceptions. Where they manifest imbecility and strange motives, it is clearly the workings of an anæsthetic brain, acting from suggestions from without or deranged impulses formed within. While a very large number of inebriates act rationally in ordinary affairs of society and business, and do not commit overt acts that come under legal recognition, it is a question if

this is not the result of accident and conditions. There are strong reasons for believing that a slight change of surroundings both mental and physical would explode the degeneration which exists and bring to light insanity, criminality, or idiocy. Instances are not infrequent of acts of lawlessness and crime in inebriates previously law-abiding and honest citizens. It was not the last use of spirits which provoked the act; this only exploded a condition which had been gathering like a storm long before. The direction and form which this disturbance would take could not always be foreseen.

The designing man who gives spirits and suggests crime and wrongdoing is in peril of being the victim himself. He is practically exploding a state of insanity, and trusting that he may be able to control it.

The inebriate or moderate drinker who uses spirits to give courage to commit some act makes the same blunder of supposing that he can paralyze the higher governing centers and still direct and control the lower faculties. Where imperative ideas and delusions already possess the brain, alcohol may intensify them for a time, but confusion and uncertainty of thought and act are inevitable.

The claim that alcohol is used for the purpose of committing crime should be a question open for evidence, and one to be considered doubtful until proved by facts that can have no other meaning. Crime committed when under the influence of spirits will be found as a rule to follow uniform lines and be very much alike in methods of execution. If spirits have been used for the special purpose of facilitating the commission of crime, very wide differences will appear. No two cases will be alike, and doubt and uncertainty will complicate the factors in every case.

These are some of the many new questions coming into prominence in the courtroom with increasing frequency every year. The present obscurity and confusion of law rulings and medical theories will be cleared away in the near future, when the subject is studied from the scientific point of view.

L'ÉLEVEUR, of Paris, has a story of a heron in England which, having lost its mate, sought consolation in constituting itself a kind of shepherd for the village. It brought the cattle to the stables, and took upon itself the supervision of the poultry, adjusting all the quarrels, and driving away unruly members of the brood. It also assumed the charge of the horses when they were harnessed, and at the first sign of restiveness restored them to quiet by giving them a peck in the nostrils. One day, when two calves had escaped, the heron, having tried unsuccessfully to drive them back, remained near them and watched them till the men came in search of them.

PRINCIPLES OF TAXATION.

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IX.—NOMENCLATURE AND FORMS OF TAXATION.

(*Continued from page 185.*)

THE nature and scope of the "legal" and wholly anomalous definition (to which reference has been made, see page 173) that has been given in the United States by its Supreme Court to a *direct* tax,* and the interesting judicial and historical circumstances in connection therewith are substantially as follows:

The Constitution of the United States provides that "representatives and direct taxes shall be apportioned among the several States according to their respective numbers"—that is, population—"and excluding Indians not taxed." The origin of the idea thus incorporated in the Constitution of proportioning direct taxes according to representation, or population, rather than upon property, is not certainly known, and has been made the subject of speculation. Hamilton, subsequent to the adoption of the Constitution, suggested that the writings of the French economists of the eighteenth century, with which a number of the prominent members of the Constitutional Convention were familiar, was its source. These held that "agriculture was the only productive employment, and that the net product from land, to be found in the hands of the landowner, is the only fund from which taxation can draw without impoverishing society." They were accordingly led to class taxes habitually as direct when laid immediately upon the landowner, and as indirect when laid upon somebody else, but in their opinion destined to be borne by the landowner ultimately. Precedents for levying taxes by apportionment were also to be found in the French *taille réelle*, which was a tax on the income of real property and laid by apportioning a fixed sum among the provinces and requiring from each its quota. The English land tax, established under William III, embodied a like provision.†

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* Chief-Justice Chase on more than one occasion judicially intimated that the definition of direct taxes by political economists can not be used satisfactorily for the purpose of construing the phrase in the Constitution of the United States. Thus, a tax on the circulation by banks of State bank notes was held not to be direct (Veazie *vs.* Fenno, 8 Wallace, 533–546), and so also of a tax on incomes of insurance companies (Pacific Insurance Company *vs.* Soule, 7 Wallace, 433).

† For further discussion of this subject, see paper by Prof. Charles F. Dunbar, contributed to The Journal of Economics, for July, 1889, and entitled The Direct Tax of 1861.

Be this as it may, the distribution of property (wealth) among the people of the American States at the time of the adoption of the Federal Constitution, as shown by the debates in the Constitutional Convention, was, very curiously, such that an apportionment of taxes according to population and representation was not inequitable. When the subject was under discussion, Roger Sherman, of Connecticut, said he "thought the number of people alone the best rule for measuring wealth as well as representation" (Elliot's Debates, v, 297). Mr. Gorham, of Massachusetts, "supported the propriety of establishing numbers as the rule. He said that in Massachusetts estimates had been taken in the different towns, and that persons had been curious enough to compare these estimates with the respective numbers of people, and it had been found, even including Boston, that the most exact proportions prevailed between numbers and property" (ibid., 300). Mr. Wilson, a leading member from Pennsylvania, said that, "taking the same number of people in the aggregate in the western settlements of Pennsylvania and in the city of Philadelphia, he believed there would be little difference in their wealth and ability to contribute to the public wants" (ibid., 301). Dr. Johnson, of Connecticut, "thought that wealth and population were the true, equitable rules of representation; but he conceived that these two principles resolved themselves into one, population being the best measure of wealth" (ibid., 303). And when the vote came to be taken in the Federal Convention on the proposition that direct taxation ought to be proportioned to representation, it passed without opposition (ibid., 302).

In the five occasions—1798, 1813, 1815, 1816, and 1861—in which the Federal Government has established a general system of direct taxation, there has been no essential and radical difference of opinion in respect to the methods and instrumentalities by which the provisions of the enactments could be made effective for the purpose of raising revenue. The amount of money desirable to raise was first determined. Then the population of each State was taken, according to the latest preceding census, and the proportion of tax proceeds respectively due was calculated.* A statute was then passed declaring that each State should pay to the Federal Treasury so much money, according to their ascertained proportionate liability of the aggregate amount which the entire Union of the States was required to raise. In each of the first four cases of such a system of taxation the several States were empowered to assume or assess in their own way

* Up to and including the direct tax of 1861, its imposition was scrupulously made in accordance with the understanding of the framers of the Constitution. Thus, the ratio of the State of New York in 1861 was returned at $2,602,918\frac{27}{100}$.

the sums for which they were severally assessed and liable to pay into the national Treasury. In the case, however, of the levy in 1861, eleven States openly in insurrection against the Federal Government, one loyal State, and one Territory (Utah) refused or neglected to pay their assessment; whereupon a law was passed by Congress authorizing the appointment of special officials, whose duty it was to go into such States as soon as it was practicable and levy the proper assessments, seizing and selling real property whenever it became necessary to enforce payments of the amount required. And these provisions of law were enforced by threat or action to such an extent that about $2,800,100 were collected up to 1870, out of an aggregate quota of $5,153,891 due from all the States that adopted ordinances of secession; the total amount assessed on all the States having been $20,000,000.

The confusion attendant on the settlement after the war of the unpaid liabilities of the impoverished insurrectionary States to the Federal Government, on account of the direct tax of 1861, finds further illustration in the circumstance, that the Comptroller of the United States Treasury decided in 1883 that the sum of $35,555, appropriated by an act of Congress to refund to the State of Georgia money expended by it in 1777, or one hundred and six years previously, for the common defense in the War for Independence, should be paid to the Treasurer of the United States, "to the credit of Georgia on account of direct taxes charged against the State." The Supreme Court of the United States also decided in 1887 (United States *vs.* Louisiana, 37, 123) that the direct-tax law in 1861 did not create any liability on the part of a State to pay the tax; and that the apportionment merely designated the amount to be levied upon the property of individuals in the several States, without any liability attaching to the State in its political and corporate character. "This decision finally left the unpaid quota of the direct tax of 1861 in precisely the same position as any other tax assessed upon individuals, which the United States has been unable or has neglected to collect in full." (Dunbar, Direct Tax of 1861, Quarterly Journal of Economics, July, 1889.)

At the time when it was proposed to enforce the tax on defaulting States by the seizure and sale of land, a doubt was expressed whether the tax in question was, in its essence, "a tax on the land and all the various estates into which the fee may have been divided, or was a tax on the owner of the land and levied on the interest of the owner in it, and on no other subordinate or incorporeal interest. But no tax was ever collected or any land sold under the act of seizure and sale." (Hillard, Law of Taxation.)

But, apart from a unison of opinion as to the methods by which

a direct tax should be levied and collected under the Federal Government, the determination of what is a *direct* tax has not been an easy matter; and the question came up for solution before the United States Supreme Court shortly after the adoption of the Constitution, or in 1794, in a case that has become historic in the annals of American jurisprudence.

Congress having imposed a tax on pleasure carriages—or chariots, as they were then termed—its collection was resisted by one Hylton, of Virginia, on the ground that such a tax was a direct tax, and had not been apportioned among the States, as required by the Constitution. The court held that the tax in question was to be considered as a tax on the expenses of living and not a direct tax within the meaning of the Constitution, as the evils which would attend its apportionment according to population would be so great "that the Constitution could not have intended that an apportionment should be made." "The Constitution," said the Court, "evidently contemplated no taxes as direct taxes, but such as Congress could lay in proportion to the census. A tax on carriages can not be laid by the rule of apportionment without very great inequality and injustice. Suppose two States, equal in census, to pay eighty thousand dollars each, by a tax on carriages of eight dollars on every carriage, and in one State there are one hundred carriages and in the other one thousand. A, in one State, would pay for his carriage eight dollars; but B, in the other State, would pay for his carriage eighty dollars." (Opinion by Justice Chase, 3 Dall., 171.)

These, and other decisions of the United States Supreme Court, have accordingly been regarded as affirming, that within the meaning of the Constitution of the United States there are only two forms of taxation that can be considered as *direct*—namely, a capitation or poll tax, simply, and without regard to property, profession, or any other circumstance, and a tax on land; and that no other taxes can be regarded as direct by the Federal authorities. It is also worthy of note that since the decision in the carriage case in 1796, Congress, in the few instances in which it has imposed a tax which it recognized as direct, has never made it applicable to any objects other than real estate and slaves.

The following additional memoranda are pertinent to this discussion: While the carriage case was pending before the United States Supreme Court in 1796, Mr. Madison, who participated in the convention that framed the Constitution, wrote to the effect that the action of Congress in imposing this tax was constitutional, but that he doubted whether the court would so regard it. Hamilton, who appeared as one of the counsel for the United States in this case, also left behind him a legal brief in which he says: "What is the distinction between *direct* and *indirect* taxes?

It is a matter of regret that terms so uncertain and vague on so important a point are to be found in the Constitution. We shall seek in vain for any antecedent settled legal meaning to the respective terms. There is none. We shall be as much at a loss to find any disposition of either which can satisfactorily determine the point." In his argument on behalf of the Government in the carriage case, Hamilton, however, mentioned such taxes which should be considered as direct; namely, direct capitation taxes, taxes on land and buildings, and general assessment. (See his brief in the case referred to.) And in rendering the decision in the income-tax case of Springer *vs.* United States, Justice Swayne also added to our historical information on this subject by remarking, that "the question of what is a direct tax is one exclusively of American jurisprudence," which is the same thing as saying that the system of American taxation is so peculiar, that the question involved has never been made a subject of legal controversy and discussion under any other, or foreign system of taxation.

This statement of Judge Swayne is one of a number of illustrations that will confront the student of the existing American system of taxation—if, indeed, it is worthy of being called a system—showing how the makers and administrators of tax laws in the United States have drifted, as it were, into uses and practices which long usage has made to appear almost as of self-evident validity, but which find no precedent in the experience or systems of other countries, and no solid foundation in any correct economic philosophy.*

There were also two reasons and two points of view in the Hylton case on which the judgment of the court might have been predicated. One was that Hylton possessed one hundred and twenty-five carriages, which warranted the inference that they were hackney carriages, kept and used for hire, and that the tax levied on each carriage ultimately fell on the consumer and not on the owner (Hylton) himself; or, in other words, the tax in question was a tax on transportation, and, as such, capable of transference to the person carried, and therefore, when imposed

* Since the statement of Judge Swayne (above referred to) was made, a decision has been rendered by the Privy Council of Great Britain, in which the recognition of direct taxation and its method of incidence by British jurisprudence is taken for granted; for in concurrence with a decision rendered by the full bench of judges concerning an opinion of one of their members, wherein he says, in speaking of a point that had been raised, that a tax must be general in order to be a direct tax, they reject that view, inasmuch as it "would deny the character of a direct tax to the income tax of this country—Great Britain—which is always spoken of as such, and is generally looked upon as a direct tax of the most obvious kind; and it would run counter to the common understanding of men on this subject, which is one main clew to the meaning of the Legislature."

on the carrier, was an indirect and not a direct tax. Another point is, that a tax on carriages has not the compulsory element which pertains to all direct taxes, as their ownership and use are optional, which is the special characteristic of all indirect taxes.

Substantially the same question involved in the carriage case came up again (in 1874) before the same court (Springer *vs.* United States, 12 Otto, 102 U. S. Reports, p. 856), when a citizen of Illinois resisted the payment of a national income tax on the ground that such a tax was a direct tax; and not being levied in the manner prescribed by the Constitution, was not legal and valid. From an economic point of view such a tax, as has been before shown, is and always has been regarded as a direct tax; and on the hearing the plaintiff adduced in support of his position the testimony, as found in their writings, of almost every acknowledged authority on political economy or finance in the English language — Adam Smith, Ricardo, Mill, Wayland, Brande, Say, Perry, as well as the Encyclopædia Britannica and almost every other cyclopædia or dictionary of English or American origin.* The court, however, held as before, that under the definition of a direct tax, as expressed in the Constitution, the in-

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* In all the debates in the British Parliament it is doubtful if any British statesman can be named who has ever spoken of an income tax as other than a direct tax. The same may be also affirmed of French authors and statesmen. The following citations of the opinions of various recognized authorities are illustrative:

"The taxes which it is intended should fall indifferently upon every species of revenue are capitation taxes." (Adam Smith.)

James Mill, under the title of "*Direct* taxes, which are designed to fall upon all sources of *income*," says, "Assessed taxes, poll taxes, and *income taxes* are of this description." (Elements of Political Economy, p. 267.)

J. R. McCulloch divides his work on taxation into two parts; Part I, on direct taxes, and Part II, on indirect taxes, and under the head of "Direct Taxes" he treats of "taxes on property and *income*."

Dr. Lieber, referring to the different modes of levying taxes, says: "The first way is direct—to determine from the statement of the parties concerned, or from official information, the net *income* of persons. This kind of taxes are called direct." (Encyclopædia Americana.)

"Taxes are either direct or indirect. A direct tax is one which is demanded from the very persons who it is intended or desired should pay it. *Direct* taxes are either on *income* or expenditure. . . . Most taxes on expenditure are direct, being imposed not on the producer or seller of an article, but immediately on the consumer. . . . The window tax is a direct tax on expenditure, so are taxes on horses and carriages." (John Stuart Mill, Political Economy, vol. ii.)

When Sir Robert Peel brought forward his plan for an income tax in 1842, he said: "*Indirect* taxation has reached its limits, and can no longer be relied on. My plan is this, to levy an income tax," etc. (Parliamentary Debates, lvi, 428; Ann. Reg., 1842, 72, 73.) And Lord John Russell said in reply: "To resort to the desperate measure of an income tax in such circumstances is nothing less than to proclaim to the world that your resources are exhausted, that indirect taxation has reached its limits," etc. (Parliamentary Debates, lvii, 86, 147; Ann. Reg., 1842, 77, 79.)

come tax was not direct but indirect, and accordingly that its imposition was not unconstitutional. The following was the exact language of the Court:

"Our conclusions are that direct taxes within the meaning of the Constitution are only capitation taxes, as expressed in that instrument, and taxes on real estate; and that the tax of which the plaintiff complains" (i. e., a direct tax) "is within the category of an excise or duty."

Whether warranted or not, the drift of public opinion in the United States has been, that the decision of its Supreme Court in the Springer case in 1874, and, to a certain extent, in all previous cases touching the constitutionality of an income tax, was made under the pressure of an apparent political necessity. Had the decision been to the effect that the income tax was a direct tax, and any method of levying it other than that prescribed by the Constitution—i. e., according to population—was unconstitutional, the Government would have been forever practically deprived of an effective instrumentality for raising revenue which might be most desirable in cases of emergency. Immense sums which had been paid under protest as income taxes would also have been pressed for repayment in case the decision had been otherwise, to the serious embarrassment of the national Treasury.

In harmony with the above decisions, the United States Supreme Court has decided that neither taxes on distilled spirits (United States *vs.* Singer, 15 Wall., 111), nor succession duties on the devolution of title to real estate (Scholey *vs.* Rew, 23 Wall., 331), nor taxes on the notes of State banks (Veazie Bank *vs.* Fenno, 8 Wall., 533), nor taxes on the receipts of insurance companies from premiums and assessments (Insurance Company *vs.* Soule, 7 Wall., 433) are direct taxes; but that all such taxes are imposts and excises, and subject, therefore, to the requirement as to uniformity, but not subject to the requirement of apportionment.

Important, interesting, and instructive from a constitutional, legal, and economic point of view, as was the experience of the United States in respect to direct taxation, prior to 1894, the sequel of events and experience in respect to this question and its involved problems has been no less important and worthy of narration.

By an enactment of Congress, August 18, 1894, establishing an income tax for the United States, a tax of *two* per cent was imposed on the gains, profits, and income of persons derived from any kind of property, including rent and the growth and produce of lands, and profits made upon the sale of land if purchased within two years. Every element that could make real or personal property a source of value to an owner was taxed. An

excise duty was also imposed upon income derived from any profession, trade, employment, or avocation. The tax upon persons generally was not upon their entire income, but on the excess over and above the sum of $4,000. All persons having incomes of $4,000 or under were exempt. The whole burden of the tax, it was estimated, would fall on less than two per cent of the population of the country. That the Government practically conceded that such a feature of the act was pre-eminently class legislation is evident from the following extract from a statement made in a brief by the Attorney General of the United States: "Congress," he says, "has adopted as the *minimum* income for the purpose of taxation the limit of $4,000. This limit may be said to divide the *upper* from the *lower middle class*, financially speaking, in the larger cities, or to divide the *middle class* from the wealthy in the country districts." (*Opening argument by William D. Guthrie, in support of the contention that the income-tax law of 1894 was unconstitutional.*)

As might have been expected, the provisions of this enactment, which could not be fairly considered pertinent and relevant to a just and equitable system of income taxation, occasioned much of dissatisfaction among business men and the financial authorities of the country generally; and measures were at once initiated to test before the proper legal tribunals—i. e., the courts of the United States—the constitutionality of the statute. The most important and immediate representatives of this action were the Farmers' Loan and Trust Company and the Continental Trust Company, of New York—two of the largest trust companies in the United States. It is also worthy of note in this connection that the above-named companies, before taking any steps to test the validity of the act in question, complied with all its provisions; no collector of internal revenue or any public officer of the United States having been made a party, or any injunction sought from the courts, to restrain the collection of the tax.

The basis of action of the above-named parties, as represented by some of the most eminent members of the legal profession in the country,* was substantially as follows: Each of them, and a large number of other like organizations—insurance companies, savings banks, and trusts—hold as investments of capital stock, earnings, and profits, and as trustees for minors, widows, individuals, copartnerships, and corporations too numerous to mention, resident in the United States and elsewhere, large amounts of real estate, situated in the various States of the Fed-

* Messrs. Joseph Choate, Clarence A. Seward, William D. Guthrie, Benjamin H. Bristow, David Wilcox, and Charles Steele. For the United States, James C. Carter and Richard Olney, the Attorney General.

eral Union, and amounting in aggregate value to hundreds of millions of dollars. The rents and income of this real estate, also annually amounting in the aggregate to large sums, are collected and received by the above-mentioned organizations, and held by them in their various fiduciary capacities.

The first point of importance under such a state of affairs to which attention is asked is, that taxes levied or laid by the Federal Government are recognized and admitted (in virtue of repeated decisions and assumptions of the United States Supreme Court) to be typical forms of *direct* taxation, and as such under a clear and carefully worded provision of the Federal Constitution must be apportioned among the several States according to their respective population.* On this point, therefore, there could obviously be no legal contention.

It is now well recognized that this provision of the Constitution, after full discussion and careful wording on the part of its framers, was adopted in order to protect to the States, which in entering into union were surrendering to the prospective Federal Government so many sources of income, the power of direct taxation, and so preclude a combination of States from exacting tribute from other States.†

The next point of contention in order of importance in the case as presented to the United States Supreme Court was; did the provisions of the income-tax act of 1894, imposing a tax of two per cent upon the gains, profits, and income derived from all kinds of property—including rent and the gains and profits accruing from the growth, profits, or sale of land—involve and create a tax which must necessarily be deemed a direct tax on real estate (land), and which not being apportioned (levied) according to the

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* "Representatives and direct taxes shall be apportioned among the several States which may be included within this Union according to their respective numbers."—*Constitution of the United States, Article I, section 2.*

† "The founders anticipated that the expenditures of the States, their counties, cities, and towns, would chiefly be met by direct taxation on accumulated property, while they expected that those of the Federal Government would be for the most part by indirect taxes; and in order that the power of direct taxation of the General Government should not be exercised except on necessity, and when the necessity arose should be so exercised as to leave the States at liberty to discharge their respective obligations and should not be so exercised unfairly and discriminatingly as to particular States or otherwise by a mere majority vote, possibly of those whose constituents were intentionally not subjected to any part of the burden, this qualified grant was made. Those who made it knew that the power to tax involved the power to destroy, and that the only security against the abuse of this power is found in the structure of the Government itself. In imposing a tax the Legislature acts upon its constituents. This is in general a sufficient security against erroneous and oppressive taxation, and they retained this security by providing that direct taxation and representation in the lower House of Congress should be adjusted on the same measure."—*Chief-Justice Fuller.*

provision of the Constitution render the entire act imposing an income tax unconstitutional and void?

The precise or original question involved, it was admitted, was one on which the Federal Government had really never been heard,* and was first brought before the United States Supreme Court for a hearing and adjudication in April, 1895. On that occasion the court held that the provisions of the act of August 15, 1895, were unconstitutional, so far "as they purport to impose a tax on the rent or income of real estate." It was, however, equally divided on the following questions, and expressed no opinion in regard to them:

(1) Whether the void provisions invalidated the whole act; (2) whether, as to the income from personal property as such, the act is unconstitutional as levying direct taxes; (3) whether any part of the tax, if not considered as a direct tax, is invalid for want of uniformity.

The court, early in its history, adopted the practice of requiring, if practicable, constitutional questions to be heard by a full court, in order that the judgment in such cases might, if possible, be the decision of the majority of the whole court. And as the court was not full, at the first hearing in April, and as four judges did not concur in the opinion then rendered, a rehearing was granted by the court in the month following (May 6th, 7th, 8th); in the announcement of which the Chief Justice remarked that "the importance to the Government of the new views of its taxing power can hardly be exaggerated."

In advocating the constitutionality and rightfulness of the provisions of the income tax of 1894, the then United States Attorney General, Hon. Richard Olney, on behalf of the Government, made in part the following argument:

"What is this" (contested) "tax in its true value and essence? It is an assessment upon the taxpayer on account of his money-spending power as shown by his revenue for the year preceding the assessment. It is not a property tax in any sense or of any sort. Yet this is the sort of tax which is called a tax on real estate for no other reason than that last year's rents form a part of the yardstick by which this year's money-spending capacity is measured! A greater error, I submit, could not easily be justified. My Lord Coke is quoted to the effect that a grant in fee of the profits of land passes the land itself. Other citations are always interesting, and state a rule of law which is indisputable

* None of the previous decisions of the court "discussed the question whether a tax on the income of personalty is equivalent to a tax on that personalty; but all held real estate liable to direct taxation only so as to sustain a tax on the income of realty on the ground of being an excise or duty."—*Chief-Justice Fuller.*

and of universal acceptance. But what is their relevancy to the case in hand? They relate to grants taking effect in future—to grants taking effect from the date or delivery of the deed, or from the probate of the devise, and carrying all after-accruing rents as a matter of course. But what this case is concerned with is rents that have not only become due, but have actually been received by the landlord. Does any one pretend that rents thus received would pass by a grant of the estate that has yielded them? Of course not, and why? Because, by falling due and being collected, they have become severed from the realty, and have become personal property—money in the landlord's pocket, like any other money. Nothing is gained, however, by belittling or evading an argument, and I have no intention of doing either. The strength of the plaintiff's claim is in the proposition that the value of land is in its use; that rents are the pecuniary equivalent of the use, and that, therefore, to tax rents is in substance and effect to tax the land itself. This is what may be called a fetching proposition. How much truth is there in it, and how much of applicability to the present case? There is this much of truth in it: that a tax upon rents to become due—to accrue in the future—may well be deemed a tax on the estate itself. Such accruing rents are like growing crops, an inseparable part of the land, and whatever is a charge upon them is necessarily a charge upon the land. But the proposition stated has no application whatever to the present case, because the tax it has to do with is a tax in respect to rents already due and collected, and in all probability either spent or transformed into other tangible property. How can a tax in respect to such rents be said to be a tax upon the real estate producing them? When they become due and are paid, just as when crops are harvested; when either process is complete, a new and distinct item of property comes into existence, and the landlord's property realizes a corresponding accretion."

In rejoinder the counsel for the appellants maintained that under the income-tax enactment in question (i. e., of August 28, 1894) a tax was imposed upon income "derived not merely from business, but also expressly upon that derived from property, and therefore directly upon the property producing the income, whether real or personal." Notably is this the case with a tax upon "rents" and the "growth and produce of land." It taxes every element of value of the land which the owner can realize from third parties. It must be clear that a tax upon what gives the land value is a tax upon the land itself. In the words of Hamilton, "What in fact is property but a fiction without the beneficial use of it?" In many cases, indeed, the income or annuity is the property itself. As one of the justices said in the

Hylton case, "Land, independently of its produce, is of no value." It scarcely needs argument to establish that anything which affects every element that gives an article its value, in the eye of the law, affects directly the article itself. In illustration of this many decisions, mainly of the United States Supreme Court, were cited, of which the following are examples:

In Brown *vs.* Maryland, 12 Wheaton, it was held by the United States Court that a tax on the occupation of an importer is the same as a tax on imports, and was therefore void.

In Weston *vs.* Charleston, 2 Peters, it was held that a tax upon the income of United States securities was a tax upon the securities themselves, and equally inadmissible.

In Almy *vs.* California, 24 Howard, it was held that a duty on a bill of lading was the same thing as a duty on the article which it represents.

In Cook *vs.* Pennsylvania, 97 United States, it was held that a tax upon the amount of sales of goods made by an auctioneer was a tax upon the goods sold.

In Railroad Company *vs.* Jackson, 7 Wallace, it was held that a tax upon the interest payable upon bonds was a tax not upon the debtor, but upon the security, the bonds.

In Philadelphia Steamship Company *vs.* Pennsylvania, 122 United States, it was held that a tax upon the income received from interstate commerce was a tax upon the commerce itself, and equally unauthorized.

"If a man seized of lands in fee by his deed granteth to another the profit of those lands to have and to hold to him and his heires, the whole land itselfe doth passe; *for what is the land but the profits thereon?*" (Coke upon Littleton, the accepted rule of law in every court in English Christendom.)

A devise of the interest or of the rents and profits is a devise of the thing itself out of which that interest on those rents and profits may issue (Patterson *vs.* Ellis, 11 Wendal).

It seems clear, therefore, that the weight of judicial opinion as expressed in the judgments of the highest courts, both in the United States and England, was to the effect that the tax imposed under the United States act of August, 1894, on the income from the use, profits, and sales of land was a direct tax, and, not being apportioned in accordance with a strict provision of the Federal Constitution in respect to the levy and collection of said tax, was necessarily unconstitutional and void.*

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* The following rejoinder by one of the counsel for the applicants (Mr. Choate) to a portion of the argument made by the Attorney General (Mr. Olney), and before cited, is pertinent and instructive, as respects the much-vexed question as to the *situs* of property for the purpose of tax administration:

"The Attorney General says, 'When a man has got the money in his pocket it is no

Apart from the leading element in this celebrated case, and on which the final decision of the court was mainly based, was that provisions in the act of 1894 establishing an income tax, being in the nature of direct taxation, and the same being not assessed in accordance with the requirements of the Federal Constitution, were void in effect. The constitutionality of the entire act was also questioned on the ground that it violated the constitutional requirements that "all duties, imposts, and excises shall be uniform throughout the United States." Thus, for example, it taxed the income of certain companies and associations, "no matter how created or organized," at a higher rate than the income of individuals and partnerships derived from precisely similar property; and denied to individuals deriving their income from shares in certain corporations and associations the benefit of the exemption of $4,000 granted to all other persons interested in similar property and business, and the like. These features of the act of 1894, although constituting most important and instructive contributions to the general subject of "taxation," are not, however, so pertinent to the immediate subject under consideration as to require at present any extended discussion.

CONCLUSION.—As the result of the hearing and discussions involving the constitutionality of the income-tax statute of August 28, 1894, the United States Supreme Court, a majority of its members concurring, gave judgment as follows:

1. WE ADHERE TO THE OPINION ALREADY ANNOUNCED, THAT TAXES ON REAL ESTATE BEING INDISPUTABLY DIRECT TAXES, TAXES ON THE RENTS OR INCOME OF REAL ESTATE ARE EQUALLY DIRECT TAXES.

2. WE ARE OF THE OPINION THAT TAXES ON PERSONAL PROPERTY, OR ON THE INCOME OF PERSONAL PROPERTY, ARE LIKEWISE DIRECT TAXES.

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longer rent.' One thing I would say about that is, that if you are going after rent as money, the tax is on personal property, and should be apportioned. But the answer is that the tax does not go after the rent as money in the taxpayer's pocket. The act of 1894 (section 27) specifies the rents as a cardinal part and element of this income return, and every man who goes up to make return has to state under oath what rent he got last year. This fiction—this difference between the name and the thing, between the substance and the shadow, urged by the Attorney General—is that, though you can not tax rent, you can tax the money in the owner's pocket received from rent. If there is one factitious argument, one pretense of a reason, one attempt to make a distinction without a difference that this court has uniformly stamped upon with all its might, it is just that. The court has repeatedly decided that such an argument is wholly unsound. What did the court mean in Brown *vs.* Maryland, when it held that a tax on the occupation of an importer is the same as a tax on imports and is therefore void? It is the source, the substance, that the act strikes at, that the court always looks to, and always has looked to, in any form and case that has ever come before it until now."

3. THE TAX IMPOSED BY SECTIONS TWENTY-SEVEN TO THIRTY-SEVEN, INCLUSIVE, OF THE ACT OF 1894, SO FAR AS IT FALLS ON THE INCOME OF REAL ESTATE AND OF PERSONAL PROPERTY, BEING A DIRECT TAX WITHIN THE MEANING OF THE CONSTITUTION, IS THEREFORE UNCONSTITUTIONAL AND VOID, BECAUSE NOT APPORTIONED ACCORDING TO REPRESENTATION. ALL THOSE SECTIONS, CONSTITUTING ONE ENTIRE SCHEME OF TAXATION, ARE NECESSARILY INVALID.

A brief word more is desirable to complete the record of the curious and instructive experience of the United States in respect to the enactment and administration of direct taxation.

Theoretically an almost ideal system, especially if made universal in its incidence and exclusive of all indirect taxes, its application under a dual form of government, such as exists in the United States, with a practical denial of resort to arbitrary action in collection, such as exists in all despotic governments, and an accepted rule that neither the "nation" nor the forty-five "States" shall tax an instrumentality of the other, will be necessarily most perplexing. These and other like circumstances, more especially the inequalities and inefficiencies contingent on the act of 1861, therefore, render it almost certain that direct taxation will not hereafter be resorted to by the Federal Government until all other means of relief for its treasury have been exhausted. With the decision of the United States Supreme Court in 1896 against the taxation of land incomes remaining unimpaired, as it probably will be unless the Federal Constitution is practically reconstructed, the enactment by Congress of another income tax which will not reach more than half the incomes designed to be reached, will probably not be attempted. When it is also considered that it will be an impossibility to separate the part of incomes of great corporations which they derive from real estate, when they necessarily use real estate in common with other property in order to derive any income, the enormous expense and interminable litigation contingent on any attempt on the part of the Government to enforce such a law will be almost beyond estimate.

NOTE.—In order to render more complete the discussion of the nature and historical experience of the "poll tax," previously given in Chapter VIII, pages 165–175, Popular Science Monthly, No. 2, vol. lx, attention is here asked to a statutory and legal action on the part of one of the States of the Federal Union that has hitherto largely escaped public attention, and which probably finds no exact precedent in history.

The antagonism between the white and colored races of the Southern States, mainly contingent on the former toleration of slavery, still continues to a large degree, although both races, by

amendments to the Federal Constitution, have been placed on terms of full legal right and equality. In no one respect does this antagonism more persistently manifest itself, than in opposition on the part of the white citizen voters to the exercise of free and concurrent suffrage by the negro citizens. Yet, in view of the restraints imposed by the Federal Constitution in respect to political or legal discriminations against the negro race, any change in the way of relief from the situation by State enactment has been regarded as impracticable. A recent constitutional convention of the State of Mississippi seems, however, to have at last most ingeniously solved this difficult political problem, by enacting that every citizen (white or black) of established age shall pay a poll tax, the nonpayment of which shall exclude him from voting; and the collection of the tax out of exempt or nontaxable property—i. e., the possessions mainly of the poorer classes—was also denied. The intent of this provision was therefore manifestly not to raise revenue, but to exclude negroes from voting by reason of nonpayment of the poll tax; and by a like covert purpose the commission of a list of petty crimes which white men do not generally commit, such as thievery, arson, and obtaining money under false pretenses, was also made a disqualification of voting; while robbery, murder, and other robust crimes which are practiced chiefly by white men were not included.

"Within the field of permissible action under the limitations of the Federal Constitution, the Mississippi convention swept the circle of expedients to obstruct the exercise of the franchise for the negro race."—*Ratliff vs. Beale, Mississippi Reports.*

In the preface to the works of Jean Rey, the philosopher who nearly three hundred years ago first suggested the cause of the increase in weight of lead and tin when burned, M. Edouard Grimaux notices some of the theories that have been put forth on the subject. Boyle explained the increase by supposing that corpuscles of fire, passing through the walls of the vessel in which the calcination took place, became fixed in the metal. This theory was accepted by Stomberg, Lemery, and Nicolas Lefèvre, and was formulated by Lemery: "The pores of the lead are so disposed that the corpuscles of the fire insinuate themselves among them; they remain fastened and agglutinated in the pliant and intricate parts of the metal without being able to escape from them, and add to its weight." Father Chérubin, of Orleans, refuted this explanation by showing that glass was not thus permeable; while Boerhaave, and afterward Boulduc, held that there was no increase of weight in the calcination of metals. Bierne, in 1753, supposed that some rich and sulphurous acid coming from the flame became fixed in the metal. Lavoisier declared the true cause—the fixation in the metal of a part of the air—in 1774, and a little while afterward, in 1775, Bayen called attention in the *Journal de Physique* to the existence of Jean Rey's Essays.

THE THYROID GLAND IN MEDICINE.*

By PEARCE BAILEY, M. D.

IN the past few years a remedy has been discovered for certain conditions hitherto regarded as incurable, which is certain in its action, and which for the beneficence of its results stands unrivaled in therapeutics; and, since from the infrequency of the diseases which it cures but little is known of this agent outside of the medical profession, it has appeared to me that a short description of the development and application of the thyroid treatment, one of modern medicine's greatest achievements, should prove of interest to any one who cares to observe the advances of medical science. The task is the more pleasant from the fact that the use in medicine of the thyroid gland of animals is a logical conclusion from adequate premises, and because the thyroid forms one of the few medicinal agents in our possession which are not given on purely empirical grounds.

It is a generally familiar fact that the majority of drugs are prescribed because medical history records that, for some unknown reason, they have proved effectual in the diseases in which they are administered, though why they should do so remains unexplained. In certain conditions mercury has a specific action, the nature of which is absolutely unknown. Quinine had cured the Countess Chinchon (and hence the name *cinchona*) of her ague centuries before a clever Frenchman discovered that malaria resulted from the activity in the blood of a vegetable parasite on which Peruvian bark exerts a restraining influence.

So it is with most of the remedies which the physician employs: he uses them because experience has shown that they will do good in the conditions in which he prescribes them, although he has not learned why. But in the use of animal thyroid the physician knows that he has a sovereign remedy, and he also knows the reasons for the brilliant results of its proper application. To appreciate the philosophy of the action of this agent requires the understanding of a few facts in anatomy and physiology which relate to what the thyroid gland is and to what it does.

In man the thyroid gland lies deep in the neck, in front and at the sides of the windpipe, and is covered by skin and muscle; its deep situation renders it difficult to be felt in the living subject. The thyroid belongs to the class of glands known as ductless—that is, there is no canal or duct by which the secretions of the gland are carried out. Its function, like the function of

* Read at Saratoga, September 2, 1896, before the American Social Science Association.

the other ductless glands (the spleen, the thymus, and the adrenal bodies), is but imperfectly understood. I shall limit myself to saying that the presence of the normal thyroid gland is necessary for health, and that it is supposed that the secretion of the gland, which enters the blood-current directly, either neutralizes some poison which, from the ordinary processes of life, is circulating in the blood, or furnishes to the blood some substance which is necessary to it. When from any cause this function of the gland is interfered with, very characteristic symptoms result. It is only within recent years that it has been recognized that impairment of thyroid function can and does cause a definite group of symptoms which constitute a disease. These symptoms may occur when a tumor develops in the gland, and will be intensified if, when the tumor is removed, much of the gland substance is destroyed.

But the most important disease of the gland itself, which is insidious, chronic, and progressive, is myxœdema. This affection is a chronic inflammation of the thyroid gland, by which the secreting structure is gradually destroyed, and which consequently deprives the patient of the good services which are rendered by a normal gland. In many respects myxœdema resembles Bright's disease, and it was some time after the first description of it by Sir William Gull before it became established that the affection depended upon the impairment of function of the thyroid gland, and not upon disease of the kidney. The most prominent symptom of the disease, and the one from which the name is in part derived, is an œdema or swelling, which, unlike the œdema of Bright's disease, does not pit on pressure. This œdema is most prominent in the face, and it is there that it begins, although later in the disease it may extend to the hands and feet, and thereby increase the general weight of the body. The lips are thickened, the nose becomes large and flat, and the eyelids are swollen. Owing to the swelling of the tongue and throat, the character of the voice may be changed. The skin is dry, rough, and peculiarly pale; the hair falls out—a symptom particularly noticeable in the eyebrows—the teeth become poor and the nails brittle. The pulse is slow, the heart is weak, and the temperature is almost always below the normal. Neuralgic pains are of common occurrence in myxœdematous patients, and cold weather is very disagreeable to them, probably on account of their low body temperature. The muscles are weak, especially those of the head and neck, and all muscular movements are slowly performed. The mind becomes dull and apathetic; there is usually developed irritability of temper. Hallucinations or perverted sense perceptions are not at all uncommon, and occasionally the affection terminates in insanity. These patients are peculiarly sensitive

as to their own appearance and to the attention which it attracts, and consequently shun society; and for this reason partly, and partly because of their muscular weakness and subnormal temperature, they like nothing so well as staying quietly in the house. The onset of the disease is gradual and its progress is slow, ordinarily extending over a period of several years. It most frequently occurs in women of middle age. Altogether myxœdema, although not a direct menace to life, makes the victim of it very uncomfortable and unhappy.

The appearance of a person suffering from advanced myxœdema is so characteristic that when one has seen a case there is usually no difficulty in recognizing another. In the earlier stages, however, when the disease is beginning, its diagnosis may be difficult or temporarily impossible.

Myxœdema is not a common disease in this country, and until five years ago was regarded as incurable. But as physicians become more familiar with the condition, which after all has only been recognized for about twenty years, and more especially as the possibility of curing it becomes more widely known, it is altogether probable that we shall find the disease less rare than we have been led to suppose.

The series of experiments which led to the employment in this disease of the thyroid glands of animals resulted in discoveries so complete and definite that it became possible to predict that the thyroid treatment of myxœdema would be a success. Before Sir William Gull described the affection and claimed for it a place of its own among the list of distinct diseases, it had been regarded as a variety of Bright's disease. But to the trained eye the resemblance of myxœdema to Bright's disease was too superficial to be satisfying; and, furthermore, when these patients died their kidneys, which would have shown disease changes if they had been responsible for the symptoms observed in life, were found to be normal. So the first step forward in our knowledge of the disease was the establishment of the fact that the seat of the trouble was not in the kidneys; it was not discovered until later that it was in the thyroid gland. This discovery came about from several sources.

It was observed by physiologists that animals from which the thyroid gland had been removed developed a condition of œdema and stupidity; and several surgeons reported that patients from whom the thyroid gland had been removed by operation for various causes developed symptoms almost identical with those of the cases which had been regarded as examples of Bright's disease, but in whom the kidneys were found nearly normal.

This experimental evidence was amplified by the work of

pathologists who, in their examination of all the organs of persons dead with myxœdema, found that there existed constant disease in the thyroid, so that it became established beyond doubt that these symptoms, which were so much like those of Bright's disease, were in reality due, not to the ordinary causes of Bright's disease, but to a chronic inflammation of the thyroid gland—a process which resulted in the diminution or loss of the function of the gland, and a consequent deprivation of the secretion which it was intended to supply.

The symptoms which ensued after extirpation of the thyroid gland, whether in man or in the lower animals, received the name of *cachexia thyreopriva*, or operative myxœdema; when the condition occurred independently of such operations—i. e., from primary disease in the gland—it was called myxœdema; but although the pathology of myxœdematous conditions thus became established, it was a long time before it became known how they could be cured; and again it was due to the ingenuity and observation of physiologists and surgeons that it eventually became possible for the physician to apply a form of treatment which has proved curative for myxœdematous conditions of whatever origin.

It occurred to physiologists that if another thyroid could be made to grow beneath the skin of an animal whose own gland had been removed, the new thyroid might assume the functions of the one which was gone; and surgeons conceived the same idea for patients from whom the thyroid had been removed at operation. This was accordingly tried: physiologists grafted sheep's glands in monkeys whose own thyroid they had removed experimentally; and surgeons put sheep's glands beneath the skin of patients who had been operated upon on account of thyroid disease. Although these procedures were only partially successful, they were the beginnings which led to the ultimate establishment of the thyroid treatment. The results of these graftings were beneficial for a time, but as the transplanted thyroid could not be made to accommodate itself to its new home, the effects soon wore away and the myxœdematous symptoms returned. The temporary benefit, however, was so pronounced that it was evident that the disease had in some way been influenced by the grafted thyroid. Since the gland at the time of its transplantation was full of its normal secretion, but could not be made to secrete further after grafting, it was inferred that the beneficial influence was solely due to the thyroid juice which the grafted gland contained. So it became evident that the successful treatment of myxœdematous conditions required an uninterrupted supply of thyroid secretion. It was not until 1891 that Dr. G. R. Murray drew this conclusion, and presented at a

meeting of a medical society in England a woman with myxœdema whom he said he intended to treat by subcutaneous injections of the extract of the thyroid gland of the sheep. When about six months later he showed the same patient, improved in every way, the success of the treatment was established.

The success which followed this experiment was so immediate and complete, and was so speedily substantiated by physicians the world over, that thyroid therapy at once became the recognized means of treating myxœdema and allied conditions.

The results of the treatment are very striking; the œdema rapidly disappears, leaving the skin soft, smooth, and moist; the

FIG. 1.—MYXŒDEMA. Before treatment.

FIG. 2.—Same patient after treatment.

mental dullness gives way to cheerfulness and hope; strength is returned to the weakened muscles, and the patient becomes once more, to all appearances, a normal individual. A large number of cases of myxœdema have been recorded as cured by thyroid feeding, and these reports are usually accompanied with photographs of the patient as he appears before and after treatment, which present most striking contrasts. Through the courtesy of Dr. John Woodman, of New York, I am able to give the reproductions of the photographs (Figs. 1 and 2) of a case successfully treated by him. A common history of the early cases treated in this way is somewhat as follows: A woman has had myxœdema for years, and has been told by many physicians that her condition is incurable, and she is indifferent and skeptical as to the value of the treatment proposed for her. In a few months it is

with difficulty that she can be recognized as the same person. The swollen, pallid, stupid face is gone, and in its place are red cheeks and the pleasant expression of a healthy woman. She can walk several miles a day, sleep well, has a good appetite, and enjoys life.

Such is the history of myxœdema and how it came to be treated by the thyroid gland of animals. Therapeutics can show no more brilliant results than these.

When myxœdema occurs in infancy or childhood it is called cretinism. The word "cretin" will recall to the minds of most of my readers visits to Switzerland or to the eastern parts of France, where these queer little dwarfs are so common. Goitre is also, curiously enough, frequent in these localities. But few are aware that we, here in America, possess cretins of our own. In the cretinous regions of Europe, where so many of the inhabitants are afflicted with the disease, it is called endemic or peculiar to the country. In America it occurs only occasionally, and not with any geographical regularity, and so such cretins are called sporadic. Now, sporadic cretinism with us is certainly a rare affection; but as the condition becomes more familiar to physicians, and as the inmates of our own idiot asylums are more carefully examined, it is possible that it will be found that cretinism, like myxœdema, is less rare than had been suspected.

The absence or disease of the thyroid gland produces much the same symptoms in the child as in the adult; the most striking difference is due to the fact that in the child development of the body and brain is interfered with, so that cretins are generally dwarfs, and the failure of mental development results in a condition closely allied to idiocy. These idiotic dwarfs are very repulsive to look at. They have large heads and necks and thick lips, through which protrudes the clumsy tongue. They have few or no teeth, and the swelling of the throat renders the voice indistinct. The nose is large and flat, and the swollen eyelids partly cover eyes which are frequently crossed. The limbs are swollen and often incapable of service; the skin which covers them is hard, rough, and thick. Cretins are always short, and may never grow taller than a normal child of two or three years. They never attain a high degree of intelligence, and most commonly are idiots with only the power to comprehend the simplest things of daily life, and with a vocabulary limited to a few words.

There are some differences between endemic and sporadic cretinism, and what follows applies only to sporadic cretins.

What has been said concerning the treatment of myxœdema by thyroid feeding may be repeated for sporadic cretinism. The changes which result from the thyroid treatment of cretins,

owing to their stunted bodies and vacant minds, are even more astonishing than those described for myxœdema; for in cretins, not only do the œdema and other general symptoms disappear, but the dwarf begins to grow, and the idiot to show signs of intelligence. One patient who, at the beginning of treatment, was sixteen and a half years old and only thirty-three and a half inches in height, and in whom no growth had occurred in fourteen years, grew four and three quarters inches in six months;

FIG. 3.—SPORADIC CRETINISM. Before treatment.

FIG. 4.—Same patient after treatment.

another, sixteen and a half years old and twenty-nine and a half inches tall at the beginning of treatment, increased six and a half inches in height in six months. Under treatment the teeth begin to grow, and the facial expression and the whole appearance of the patient are radically changed. The patients soon become more intelligent and appreciative of their surroundings, and many begin to talk and to understand what is said to them. How striking may be the improvement in the general appearance is shown by Figs. 3 and 4, which are reproductions of photographs of a little patient treated by Dr. J. C. Carson, superintendent of the Syracuse Institution for Feeble-minded Children.

That the results will be permanent, and that these idiotic children will become, under the influence of the thyroid treatment, intelligent men and women, it is as yet impossible to say.

The occurrence, in the formative period of infancy and childhood, of a disease which attacks fundamentally nutrition, development, and growth, has much more disastrous effects than when its appearance is delayed until the organism has reached maturity.

And while it is possible that the removal of causes inhibitory to growth may result in a gradual return of developmental processes, the thyroid treatment of infantile myxœdema has in no case been carried out for a sufficient length of time to permit the assertion that such will be the case. In no case is treatment reported to have lasted more than three years, and in few cases is it said that the patient is in all respects cured; but from the fact that in nearly all of the cases treatment was not instituted until the child was several years of age and had developed but little or not at all for a considerable length of time, several years would be necessary, by the natural processes of development, for the complete re-establishment of normal growth.

Although data sufficient to justify positive assertions are lacking, it seems entirely in the range of possibility that if the treatment of sporadic cretinism were begun at the outset of the disease, before growth was seriously interfered with, it would permit the proper development of the child without myxœdematous symptoms as long as the thyroid was administered.

From the consideration of the history of myxœdematous conditions it will have been seen that all this treatment promised to do was to supply to the body the necessary substance which the thyroid gland was no longer able to produce. It never undertook to supply a new thyroid gland; and the disappearance of the symptoms of myxœdema under the thyroid treatment means that the necessary secretion is being artificially supplied, and not that the function of the gland has been restored.

Consequently, any one in whom the activity of the thyroid gland has been lost, whether it be by myxœdema, or operation which has induced the condition of cachexia thyreopriva, must continue the use of the thyroid glands of animals for the remainder of life. Dr. Murray's original case is still taking thyroid, and after five years remains well.

The therapeutic use of the thyroid has now been tried in many other conditions with varying success. From its efficacy in reducing the size of ordinary goiters it has to a great extent supplanted the knife in the treatment of that condition. Recent reports from Germany would seem to indicate that it exerts a beneficial influence upon the development of children who are physically or mentally backward, although they have none of the characteristic symptoms of cretinism. Its power to reduce excessive fat is becoming very widely known, and when properly

used it certainly is a valuable agent for this purpose. In many diseases it may prove to be of service, though, aside from its use in myxœdematous conditions, exactly what place in the materia medica should be assigned to it, it is as yet impossible to say. The gland is obtained chiefly from the sheep, and is usually administered in the form of a dried powder or in tablets. Alarming symptoms may occur as a result of overdosage; such symptoms consist in too rapid loss of weight, or feeble heart action, or lowering of the temperature; they usually subside when the remedy is stopped. It should be remembered, however, that it is a mysterious and powerful agent, by no means destined for indiscriminate use.

In conclusion, it may be said that the introduction into medicine of the thyroid gland is a logical conclusion from adequate premises. It resulted from scientific experimental and chemical study by trained and skillful workers, and it has nothing in common with the largely advertised "organic extracts," which are false in theory and worthless in practice.

Animal thyroid is by no means a cure-all, and even in myxœdematous conditions which have existed for many years it may be unable to repair the ravages of the disease; but it has shown itself, when appropriately applied, to be among the most unfailing therapeutic agents in our possession.

THE DESPOTISM OF DEMOCRACY.

By FRANKLIN SMITH.

"WHATEVER crushes individuality," says John Stuart Mill, describing the essential feature of all political governments, "is despotism, by whatever name it be called, and whether it professes to enforce the will of God or the injunctions of men." * Be the government autocratic, aristocratic, or democratic, the power it wields in restraint of natural rights, or of equal freedom, puts it under the ban. Decked though it be with motives worthy of the noblest philanthropy, aim though it may to fill the world with saints, it is vitiated by the love of power and by the check it puts upon the natural growth of character. It would make all men, not like the diversity of Nature, but like the figures of Egyptian art. If democracy as well as autocracy and aristocracy has sought to accomplish this task; if the former as well as the latter, in the pursuit of an enterprise that has always ended and must inevitably end in disaster, has put shackles on the individual in the form of laws and seized his property under the guise of

* On Liberty. Ticknor & Fields edition, pp. 122, 123.

benevolences and taxes, it is none the less despotism because the crime is done in the name of the people. Nor is it any the less a fit object of execration because it does not bear the title of Cæsar or the Council of Ten.

I.

That democracy should be thought the protector of freedom and property is natural. Despite the dense clouds of cant and metaphysics that have enveloped it, the idea has a historic basis. The growth of civilization has been largely an abatement of the monopoly and amount of political control. Human society did not begin, to use the phrase of Hobbes, "with the desolate freedom of the wild ass." Morgan and Maine have made it a commonplace of science that there was never a time when the members of the primitive group had the rights and immunities conferred only upon those possessed of the power of moral control. "Mankind," says Prof. Burgess, confirming the truth of a social philosophy he rejects, "does not begin with liberty. Mankind acquires liberty through civilization." * It is first subjected to a double dominion —that of custom and that of the leader become autocrat through the fortunes of war. To him belong the person and property of his subjects, to be used as whim or interest may direct. "Kings," said Louis XIV, expounding the doctrine of autocratic despotism, "are absolute lords, naturally possessing the entire and uncontrolled disposal of all property, whether belonging to the church or to the laity, to be exercised at all times with due regard to economy and to the general interests of the state." † The political philosophy of English autocracy was the same. "As the father over one family," said Sir Robert Filmer, the apologist for the despotism of Charles I, "so the king, as the father over many families, extends his care to preserve, feed, clothe, instruct, and defend the whole commonwealth. His war, his peace, his courts of justice, and all his acts of sovereignty tend only to preserve and distribute to every subordinate and inferior father and to their children their rights and privileges, so that all the duties of a king are summed up in an universal fatherly care of his people." ‡

Here is the point of departure in the long and desperate struggle against political control—a struggle that occupies the greater part of the history of civilization. If autocratic despotism has not, as in the East, deprived men of the desire to live their lives in their own way and to profit from their own skill and

* Political Science and Constitutional Law, vol. i, p. 88.

† Works of Louis XIV, quoted by Say. Political Economy, third American edition, Philadelphia, 1827, p. 411.

‡ Two Treatises on Civil Government, by John Locke, preceded by Sir Robert Filmer's Patriarcha, p. 21.

energy, they find it intolerable. They lapse into doubt as to the divinity, benevolence, and wisdom of the master that holds them in bondage. Like the English barons, they unite to wrest from him some right or privilege, some bar to the arbitrary seizure of their person and property. With the triumph of their courage and efforts passes the power of the one to the hands of the few. As a landed aristocracy, like that of feudalism, or as a commercial oligarchy, like that of Florence and Venice, they become the new despots. They, in turn, rule by divine right; their voice is the voice of God; and disobedience to their commands becomes impiety and treason. While they have introduced, in a measure, the reign of liberty in the ordering of their own lives, the many are still the victims of unmitigated despotism. Whether it be in Greece or Italy, in Spain or England, in France or Germany, their lives and property are not their own. Describing the government of lower Austria at the close of the middle ages, Navagero tells us that there were "five sorts of persons—clergy, barons, nobles, burghers, and peasants." Of the peasants, however, "no account" was made, because they had "no voice in the Diet." But there was still a sixth sort—the servile laborers—of even less account. Yet the peasants were hardly better off than slaves. They were not merely obliged to bear much heavier taxation than the barons, nobles, and burghers, but they had no part in tempering its weight. That, as in other aristocratic countries, was the arbitrary work of the upper classes. As in other countries also, the upper classes determined their own burdens.* There was still to be won for the lower classes the same right. Not only must they be permitted to fix the amount of their taxes, but they must have exemption from arbitrary seizure; they must have impartial justice; they must have deliverance from the countless restraints upon their freedom. When these conquests of the masses over the classes have been made, there is then the advent of democracy, the power that so many fear and hate, that so many hail as the beginning of a better day. Misrepresented as it has been by friend and foe, it signifies nothing more dreadful or more wonderful than the possession of the right of every man to direct his own life as seems to him best. It is the application to politics of the fundamental principle of Protestantism—the concession of the same freedom in individual conduct as is granted in individual belief.†

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* James Russell Lowell. Collected Works, vol. vi, p. 14.

† "As it is useful," says Mill (On Liberty, Ticknor & Fields edition, p. 109), "that while mankind are imperfect, that there should be different opinions, so is it that there should be different experiments of living; that full scope should be given to varieties of character, short of injury to others, and that the worth of different modes of life should be proved practicable when any one thinks fit to try them."

Little as this truth is recognized and practiced, it lurks in the current political discussions. If it is not openly proclaimed, it is tacitly implied. Mr. Godkin defines democracy as "the participation of the whole community in the work of government."* Bringing out more distinctly the idea that it is something besides the universal possession of political power, Sir Thomas Erskine May defines it as "a principle or force, and not simply an institution."† More specific still, Mr. Lowell describes it as a "form of society, no matter what its political classification, in which every man had a chance and knew that he had it."‡ Mr. Morley also holds that it means something more than political sovereignty put into the hands of everybody. Showing that as such it has shattered the old forms of despotism and enlarged the opportunities of life for all, high and low, rich and poor, he says: "It has shaken the strength and altered the attitude of churches, has affected the old subjection of women and modified the old conceptions of the family and of property, has exalted labor, has created and dominated the huge enginery of the press, has penetrated in a thousand subtle ways into the whole region of rights, duties, human relations, and social opportunities."# It is Boudrillart, however, that brings out the truth that democracy, properly speaking, is a form of moral control as well as a condition of freedom. After saying that modern democracy "permits a larger and larger number to enjoy the moral, intellectual, and material possessions of life," and "undertakes to substitute merit for favor and right for injustice," he adds: "It takes shelter behind the doctrine of perfectibility, which applies not only to the achievements of the human mind, to the discoveries of science, to the inventions of industry, but to the social condition and to the political and economic conditions that favor it. . . . To let each man be more and more a man," he continues, emphasizing the need of moral control to check the possible license of freedom—"that is to say, realize more perfectly the type of humanity, by the development of all that constitutes it—such is the end to which democracy aspires. Development of power for the individual and for the race—that is its ideal."‖

II.

Finding little cheer in the contemplation of the ideal toward which the evanescence of political control and the growth of moral control have been taking the human race, the students of democracy are often weighted heavily with foreboding. It seems to portend some disaster that no man can avert. "There is no

* Atlantic Monthly, February, 1897, p. 157. † Democracy in Europe, preface, p. vii.
‡ Collected Works, vol. vi, p. 33. # Littell's Living Age, June 13, 1896, p. 643.
‖ Block. Dictionnaire de la Politique, vol. i, p. 635.

mincing the matter," says Mr. W. E. Forster: "unless the world goes back, democracy must go forward."* "The democratic principle," says Maine, regarding it as a militant power like some barbarian horde, "has gone forth conquering and to conquer, and its gainsayers are few and feeble."† "To attempt to arrest the progress of democracy," says De Tocqueville, in the same melancholy vein, "seems like opposition to God, and it remains for the nations of the earth to adjust themselves to the conditions imposed by Providence."‡ But when viewed in the light of the far-reaching and hopeful inductions of Herbert Spencer, democracy, to many minds so fraught with peril to civilization, is divested of terror. They show not only why it is honored with the vast moral, intellectual, and material achievements of the last four centuries, but they show also why it is charged with the intolerable social and political evils that have blackened and still blacken the pages of history. By the operation of the law of evolution, as immutable as any law of Nature, the agencies of human effort, whatever be their purpose, have been enlarged almost to an infinite degree, and made immeasurably more perfect and useful. By the operation of another law, equally immutable, has been decreed the character of those agencies; it has determined whether the beliefs, institutions, and morals of a nation shall be those of savages or those of civilized men—those of war or those of peace.

Subjected to the solvent power of these inductions, all the phenomena of social life yield their secrets. They disclose the truth that feudalism, from which modern society took its origin, was not due to soil, nor climate, nor race; it sprang from the murder and pillage of mediæval barbarism. Of the same remorseless Fury were born its machinery of despotism and its hideous traits. She was the mother of the hatred, cruelty, greed, and lust that afflicted the world for a thousand years and still afflict it. Industry, however, has been the mother of peace, liberty, honesty, and virtue. Without security and freedom, traffic in labor and its fruits is impossible. Men must be protected from robbery; they must own themselves as well as their toil; they must have the right to exchange; they must be exempt from seizure and confiscation. Nor can traffic thrive without the benignant spirit of kindness and courtesy. It demands an effort to please, and the effort to please begets the habit of pleasing. It demands honesty and confidence, the basis of credit and a potent stimulus to enterprise. But traffic is a ship freighted with wealth, which gives leisure and permits the culture of the noble

* Address as Lord Rector of the University of Aberdeen. Quoted by May, Democracy in Europe, vol. i, introduction, p. 29.

† Popular Government, p. 5. ‡ Démocratie en Amérique, introduction, p. 6.

side of life—literature, art, science, philosophy, philanthropy. Shall any one say, then, with Renan, that "the origin of all civilization is aristocratic," that it is "the work of aristocrats"?* On the contrary, its origin is democratic; it comes of freedom and self-control; it is the work of toil, so despised and oppressed in every feudal land.

Yet it is heard on every hand that, as civilization advances, political government—that is, the restraints of feudal despotism—must increase; otherwise the world will stop, and its lights go out. The cry is not from the throats of ignorant demagogues or rapacious politicians; it is raised by the most studious and thoughtful. "Law," said John Randolph Tucker, before the American Bar Association, "must grow with civilization, or," he added, showing that he had yet to learn what civilization means, "progress will cease, and the achievements of a people will be unworthy of their genius and their character."† Although Mr. Lecky has declared that the tendency "in the midst of the many and violent agitations of modern life to revert to archaic types of thought and custom will hereafter be considered one of the most remarkable characteristics of the nineteenth century," he, too, believes it to be "quite true that the functions of government must inevitably increase with a more complicated civilization."‡ Even Mr. Godkin, who says most truly that "the best thing in the world is individual freedom," and that "a man who is compelled to work by law . . . is to all intents and purposes a slave," holds that "the world, through the increase of its offices and activity, needs far more regulation than it used to need."* But the growth of law, the increase of functions and regulations, the creation of officials to correspond with both, is not progress—it is, as Mr. Lecky himself hints, retrogression; it does not point to the future—it points to the past; it is not the dawn of a better day—it is a return to the curse of the middle ages. No tribute to the purpose of official machinery can hide its kinship with feudalism. Nor can any sophistry blot out the fact that such machinery is only an attempt to fit the institutions of that hated and decadent form of social life, whose object was the prosecution of war, to modern social life, whose object is the cultivation of peace and industry, as well as self-control. The current belief that it will be more successful in the future than in the past is the most amazing delusion that ever lodged in the human mind. There is no magic in the diffusion of the irresponsible power of the one among the

* Caliban, pp. 77 and 91. Quoted by Maine, Popular Government, p. 42.

† Proceedings, Milwaukee, 1893, p. 203.

‡ Democracy and Liberty, vol. i, p. 335; vol. ii, p. 228.

* Democratic Tendencies. Problems of Democracy, p. 195, and Atlantic Monthly, February, 1897, p. 158.

irresponsible many. Wisdom and virtue do not increase with the multiplication of the greed and ignorance intrusted with the management of an important and difficult enterprise. Forty millions of despots under the hierarchy of other despots trying to force thirty millions of subjects under the same debasing rule, to live a life not their own and to contribute money to a use they have no interest in, is just as much a form of feudalism as the government of a Bourbon prince or of a council of Spartan ephors.* It is just as certain to evoke the same evils and stir up the same revolt that have overthrown every other despotism.

Ignored as this truth has been and still is in speculation and practice, it has been tacitly recognized and acted upon. That is why the tyranny of the majority has been branded as no better than the tyranny of the minority; why publicists from Aristotle to Mill and Spencer have declaimed against its perils; why so much has been done in contravention of the belief that progress is to be sought through an increase of these perils; why scheme after scheme for the selection of representatives, for the restriction of legislatures, for the appointment of officials, and for the prevention of extravagance and fraud, have been invented; why every one of them has failed, and must inevitably fail. The virtue of human wit is not greater than the virtue of human character. A system of regulation can not be devised that will not yield to some plan to subvert it.† "If, in Greece," says Polybius, describing an experience constantly duplicated in modern democracies, "the state intrusts to any one only a talent, and if it has ten checking clerks, and as many seals, and twice as many witnesses, it can not insure his honesty." ‡ But with character any political system

* Here we have an explanation of Mill's statement (Liberty, Ticknor and Fields edition, pp. 135, 136) that "the spirit of improvement is not always the spirit of liberty, for it may aim at forcing improvements on an unwilling people." He adds very truly that "the only unfailing and permanent source of improvement is liberty, since by it there are as many possible independent centers of improvement as there are individuals."

† One example is the Raines law and its amendments, which led to the invention of the Raines hotel and clubs to circumvent the legislator. Another example is the new German bourse or anti-option law that the corn and produce merchants of Berlin have, according to a cablegram in the Evening Post of May 13th, discovered ways to evade.

‡ Quoted by May, Democracy in Europe, vol. i, p. 126. "The number of defalcations of county treasurers," says Mr. Roberts, Comptroller of New York (Annual Report, 1897, p. li), "brought to my attention induced me to inquire of every county clerk in the State as to whether there had been any defaulting treasurer in his county of late years. The replies received show defalcations or shortages in twenty-three counties. In some cases there was one; in some two; and in one several." Referring to "internal improvements" and other business enterprises in the United States, Prof. John W. Million says, in his State Aid to Railroads in Missouri, p. 30: "There is not a single case in the whole list of the States attempting the construction or the assistance in the construction of public works between 1825 and 1840 in which there is evidence of commanding administrative ability. In the case of almost all there is an absence of what can be called immaculate honesty." In his

will work; without it, none. When, however, human nature has grown perfect—that is to say, when civilization has reached its goal—political government will have ceased, and the only government will be that of self, or conscience. Such government will suffice to prevent the aggressions that philanthropists and statesmen strive in vain to suppress. It will also permit the fullest liberty, the highest development, and the greatest happiness both for the individual and for the race. "Not to crush minorities under the majority, the individual under centralization, liberty under equality," says Boudrillart, stating the problem thus solved, "that is the destiny of democracy." *

III.

Nothing could be more indicative of the fact that democracy as a form of political government is only a form of despotism than the exhibition of certain traits otherwise inexplicable and absurd. As the heir of the irresponsible one and the few, it arrogates to itself their attributes of divinity, and like them exacts from its subjects a slavish homage and obedience. Although Aristotle said that in a democracy "a people knowing itself to be king assumes all his pretensions," the truth has yet to be learned and acted upon. "The modes of addressing the multitude," writes Maine, after describing democracy a second time as monarchy inverted, "are the same as the modes of addressing kings." † "O king, live forever," said the Oriental courtier as he approached his irresponsible master. ‡ "The voice of the people is the voice of God," cries the courtier of democracy. "Your ascent to power," exclaims an American Bossuet, addressing the Grand Monarch of the New World, "proceeded as uniformly and majestically as the laws of being, and was as certain as the decrees of eternity." * How the obsequious practices of despotic states have been revived under popular government has not escaped the attention of Mr. Godkin. "In talking on such subjects as the currency with a view of enlightening the people," he says, "skillful orators are very careful to repudiate all pretense of knowing anything more about the matter than their hearers." ‖ But they must do more

review of State railroads undertaken since 1840, he finds that the causes of failure were "two in number: (1) incompetency and (2) corruption." (Ibid., p. 222.)

* Block. Dictionnaire de la Politique, vol. i, p. 640. The same view is to be found set forth in James M. Woolworth's address before the American Bar Association, Saratoga, 1896 (Proceedings, pp. 317, 318): "This is the vital and mighty fact of modern Christian civilization," he says, "the integrity of every human soul and its right to the possession, exercise, and enjoyment of all its faculties, capacities, and activities as to it seems good, and in such full measure as is consistent with the same right of others."

† Popular Government, p. 77. ‡ Spencer. Principles of Sociology, vol. ii, p. 148.

* Bancroft. Quoted by Maine, p. 77. ‖ Problems of Democracy, p. 90.

than that; they must represent their hearers as omniscient. "When," said an orator in the last presidential campaign, discussing the most complex of political issues, "I see a person who says it is too difficult for the people, I find some one who says it is too deep for him. No question is too deep for the people."* Had any sycophant of Nero's time pretended to more knowledge than the tyrant himself, he would have lost his life. In these days of humane societies, however, the penalty is less severe but not less summary. Howls of derision and certain defeat await the suitor for popular favor that neglects to burn the incense so pleasing to the many, and dares to say that they not only do wrong but often do most grievous wrong; that universal suffrage, however lauded as a cure for political and social ills, never insures the choice of the most fit to rule;† that there is a deal of ignorance and crime that masquerades under the name of democracy. As well might the scoffer at the divine right of kings or the infallibility of Popes two centuries ago have expected to be received with honor and cordiality at the Vatican or the palace of Versailles.

When the power of democracy is increased—that is, when government assumes more functions, thus emulating the "universal" parent of Sir Robert Filmer's political philosophy—the more despotic, intolerant, and barbarous it becomes.‡ More offices and privileges are thrown into the political arena to be fought for. Party organization grows stronger, and party feeling more bitter and savage. The pursuit of politics becomes a form of civil war, giving rise to its ethics and its evils. Division of the people into hostile camps follows. Military discipline, transferred to civil life,

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* William J. Bryan. Speech in Pittsburg, Pa., August 10, 1896.

† It was cited against an eminent American scholar and diplomatist, who was once mentioned for the governorship of New York, that he had written a paper in favor of a restriction of suffrage as a measure to improve the government of American cities.

‡ No one will forget the fierce but senseless resentment shown toward Minister Bayard by the press and Congress for his remarks on democracy in Boston, England, August 2, 1895, and in Edinburgh, Scotland, November 7, 1896. What he said was the exact truth. "The President," he said at Boston, "stood in the midst of a strong, self-confident, and oftentimes violent people, men who sought to have their own way. It took a real man to govern the people of the United States." The riots at Homestead, Chicago, Cleveland, Buffalo, and Pittsburg justify every word. "In my own country," he said at Edinburgh, "I have witnessed an insatiable growth of a form of socialism styled protection, which has done more to corrupt public life, to banish men of independent mind from public councils, and to lower the tone of national representation than any other cause. . . . It . . . has sapped the popular conscience by giving corrupting largesses to special classes, and it throws legislation into the political market, where jobbers and chafferers take the place of statesmen." Observe what has been going on in Washington since the introduction of the Dingley bill. But the only mistake Mr. Bayard made was in not distinguishing clearly between democracy as a form of political government and democracy as a condition of freedom under moral control. It is the former and not the latter that is responsible for the evils that he describes so accurately.

is enforced. Leaders spring up to take command of the political organizations, the modern *condottieri*, always agents of crime and despotism. They fight campaigns as they would fight battles; and they fight them with no more principle than the lawless bands that plundered Italy and Spain at the close of the middle ages.* If divided counsels are fatal in war, they are equally fatal in politics. Nothing, therefore, becomes more odious than independence in thought and action; and nothing is more sternly rebuked, and, if possible, severely punished.† Only the utmost fidelity is approved, and rewarded with either appointments, or contracts, or legislative favors. The policy adopted is, not what is right, but what is expedient. The demoralizing principles of Jesuitism assume control, and the end, which is party triumph, is made to justify its achievement by any means. Hence, caucus tricks and crimes, convention intrigue and outrage, bribery and fraud at elections, and sophistry and falsehood in political discussion. Hence, the exclusion from public life of men that loathe these practices and refuse to sell their souls to the Mephistopheles of politics. Hence the dominance of men, including even the "scholar in politics," so quickly debased, that never hesitate to purchase power by the creation of offices or by the plunder of the rich. Hence the low tone, the scenes of violence, and the marked decadence of all legislative bodies in every part of the world.

No fine phrases of social or political speculation can mask the odium of the fact that the spirit of democracy, like that of other

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* The parallel is quite perfect. It will be remembered that the Italian freebooters on both sides used to have "rings"—that is, understandings by which they profited as much as possible from their warfare and at the same time did each other as little damage as possible. See Prescott's Ferdinand and Isabella, vol. ii, p. 279. In Spain, as in the United States, it was found necessary for good citizens to band themselves together to secure protection from those that should have protected them. The Hermandad, or Holy Brotherhood, was the analogue of our Good Government Clubs, Citizens' Unions, etc. (Ferdinand and Isabella, vol. i, pp. 26, 186.) By the way, there could be no more convincing evidence of the capacity of people to look after themselves without the aid of the state—that is, the politicians—than the existence of such organizations as these clubs and unions throughout the country to look after the politicians. Is it not absurd to suppose people that have to form voluntary organizations to watch their government and to prevent it from driving them into bankruptcy by its incompetency and dishonesty are unfitted to form voluntary organizations to undertake enterprises that social reformers have come to imagine government alone fitted to undertake?

† A striking example of this kind of intolerance is to be found in Senator Platt's letter of May 8, 1897, on the Citizens' Union of New York. "It can't prance around," he said, "with the agile irresponsibility of a self-constituted committee of 'best citizens.' It can agree to no basis of union which substitutes the government of an individual acting wholly on his own whims and caprices for the rule of an organized responsible party performing an authorized party policy." Rather than have good government independent of any particular party organization, Senator Platt, echoing the sentiment of his lieutenant, Mr. Lauterbach, would see the triumph of its enemies.

despotisms, is selfish and sordid. The truth is exploited in every work of history and politics. "The love of exercising power," says Buckle, drawing upon his vast knowledge, "has been found to be so universal that no class of men who have possessed authority have been able to avoid abusing it."* Madison, who was a friend of democracy, thought the same. "Where there is an interest and a power to do wrong," he says, "wrong will generally be done, and not less readily by a powerful and interested party than by a powerful and interested prince."† Maine, who was quite as friendly toward aristocracy, agrees with him. "Under the shelter of one government as of the other," he says, "all sorts of selfish interests breed and multiply, speculating on its weaknesses and pretending to be its servants, agents, and delegates."‡ Even one of the most distinguished high priests of democracy does not pretend that it will be more unselfish than any other despotism. "Having forged an instrument for democratic legislation," says Mr. Labouchere, alluding to the establishment of universal suffrage, "we shall use it."* To be sure, democracy does not propose to create hereditary privileges. It will continue to wage, as it has waged, relentless war against them, and will not cease until it has crushed them. But it creates privileges of its own not less odious nor less violative of the laws of political science and the rights of individuals. It permits its subjects to plunder one another as pitilessly as the barons of the Rhine. With the aid of duties and bounties, defended with the logic of philanthropy, manufacturers grow rich "beyond the dreams of avarice." Appealing to the same feudal argument, trades and professions gain possession of monopolies as despotic and intolerable as the mediæval corporations. Commissions, created to provide politicians with place and pelf, and duplicating the *intendants* of the old *régime*, threaten the destruction of that institution so famous in history and so dear to the American heart—local self-government.‖ Even philanthropists, under the spell of a sympathy that eclipses their judgment, band themselves together to exercise an authority in the suppression of vivisection that will eventually subvert the freedom of science as well as the freedom of the community.

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* History of Civilization, vol. i, p. 280.

† Quoted by F. N. Judson. Proceedings of the American Bar Association, 1891, p. 239.

‡ Popular Government, p. 87.

* Quoted by Maine, pp. 43 and 44, from Fortnightly Review of March 1, 1883.

‖ For no other purpose than the one indicated in the text, the New York State Legislature added a fourth member to the Railroad Commission. Other commissions were proposed, but the public criticism was so severe that they were abandoned.

IV.

"The really alarming feature connected with the growth of democracy," says Mr. Godkin, apparently astonished at this natural and inevitable abuse of power, "is that it does not seem to make adequate provision for the government of this new world [of modern industry]. Its chief function, like the chief function of the monarchy which it has succeeded," he adds, showing an unconscious recognition of the cause of the evil, "is to fill offices."* But what other form of despotism has ever made adequate provision for anything beyond the preservation of order and the prevention of aggression? Has not the government of the one tried it and—failed? Has not the government of the few tried it and—failed? Let the moral, intellectual, and industrial history of every country on the face of the earth answer. For centuries despotism, either autocratic or aristocratic, strove in the interest of self-preservation to regulate the beliefs of men. Even the portly volumes of Dr. White on The Warfare of Science scarcely suffice to record its incalculable harm. It made cowards, hypocrites, and martyrs. It drove virtuous and industrious populations from their homes, crippling forever Protestant France and the Spanish Netherlands. Never has it laid its fingers on any enterprise, whether its motives be greed or virtue, without blighting it like a plague, and summoning, like an evil spirit, all the malevolence that war has planted in the human heart. "The first inevitable consequence was," says Buckle, recounting its attempts to regulate trade, "that in every part of Europe there sprang into existence numerous and powerful gangs of smugglers, who lived by disobeying the laws which their ignorant rulers had imposed. These men, desperate from the fear of punishment, and accustomed to the commission of every crime, contaminated the surrounding population; introduced into peaceful villages vices formerly unknown; caused the ruin of entire families; spread, wherever they came, drunkenness, theft, and dissoluteness; and familiarized their associates with those coarse and swinish bebaucheries which were the natural habits of so vagrant and lawless a life."† Most significantly does he add that with the abolition of the laws vanished the crimes and the criminals they had created. But the despotism of democracy has yielded no better fruit. "The public have seen law defied," says President Charles W. Eliot, describing the attempts to control the American liquor traffic in the interest of virtue; "a whole generation of habitual lawbreakers, schooled in evasion and shamelessness; courts ineffective through

* Democratic Tendencies. Atlantic Monthly, February, 1897, p. 159.

† History of Civilization, vol. i, pp. 278, 279.

fluctuations of policy, delays, perjuries, negligencies, and other miscarriages of justice; officers of the law double-faced and mercenary, legislators timid and insincere, candidates for office hypocritical and truckling, and officeholders unfaithful to pledges and to reasonable public expectation."*

"But," urges some philanthropic statesman, enamored of quackery for social and political ills, "is it not possible to frame laws with sufficient skill and to get them enforced with sufficient vigor to hasten human progress? Too intolerable altogether is it to await the slow pace of evolution." Intolerable though it be, it is far less so than the remedy urged, which was foredoomed from the first to inevitable disaster. It is a flagrant violation of the law of social and physical growth. The union of merit with benefit is as vital as the union of breath with life. The severance of the one is punished with the same certainty and severity as the severance of the other. Men must not be deprived of the fruits of their talents and toil; they must not be allowed to escape the penalties attached to ignorance and indolence. Protection against this law was the inherent and destructive vice of the rule of the one and of the few; it is the vice also of the rule of the many. "When despotism," says Boudrillart, catching a glimpse of this truth, "becomes the *régime* of a nation, is it not its fatal law to revive favors and privileges, and to destroy equality for the benefit of the low and unworthy?"† As if fresh from the study of the national, State, and municipal governments of the United States, Maine replies in the affirmative. "When the ingenious legislator," he says, "had counted on producing a nation of self-denying and somewhat sentimental patriots, he finds that he has created a people of Jacobins or a people of slaves."‡ Necessarily is it so. Self-interest, enlisted in behalf of the prostitution of public affairs, as must be the case under every form of despotism, can produce nothing but inefficiency and corruption. A powerful bureaucracy can only destroy the independence of a people and render them unfit to care for themselves. If they have not wholly lost spirit, any failure to give them relief from the woes they have been taught to charge to the government is certain to turn them into rioters and revolutionists. It did so in Greece and Rome; it did so in the Italian republics; it will do so in their modern successors.

Of the many "problems of democracy" that now vex the victims of social and political speculation, there is one at least that admits of solution. It is the utter unfitness of any class of people to exercise special dominion, even though they be "leading citi-

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* Atlantic Monthly, February, 1897, pp. 179, 180.

† Block. Dictionnaire de la Politique, vol. i, p. 641. ‡ Popular Government, p. 176.

zens" or distinguished philanthropists. The assumption that they are an unfailing depository of virtue to be graciously and mysteriously diffused among the poor and ignorant, so generally regarded as the greatest peril of modern democracy, is another astonishing delusion. To expose it, I shall not appeal to the lives of fighting ecclesiastics that led armies to slaughter, thus violating the gospel of peace, and practiced in private and public the current morals, nor to the lives of the philosophers and statesmen that befogged the interests of the people with sophistry and falsehood and gave themselves up to vice and crime. I can not hope to deepen the significance of the pleas of apologists that they were simply the creatures of their age, obedient only to its code of ethics. I call attention rather to history more recent and impressive—to the history of the day, which discloses a divergence quite as profound between preaching and practice. It shows that, as the morals of every class are molded by the same forces, they are very much alike. Inspect, for example, those of the wreckers of banks and railroads, and of the promoters of fraudulent enterprises. Are they better than those of the burglar or thief? Inspect, also, those of the "influential citizens" that intrigue and bribe for municipal contracts and privileges.* Do they differ from those of the ward heelers that conspire for places they are not fitted to fill, or of the public officials that peddle protection to gamblers and harlots? Inspect, again, those of the illiterate and impoverished "gang" that flock to a State Legislature to become the chartered pilferers of some metropolis. Are they worse than those of the more intelligent and prosperous "gang" that besiege the national Legislature for a similar purpose on a greater scale? Inspect, finally, those of the people that revel in books on a Corsican barbarian, in series of articles hideous with the atrocities of war, and in newspapers reeking with vulgarity and crime; that hear without a shudder of the annual slaughter of victims more numerous than the Greeks of the Anabasis;† that preach rancor and revenge toward

* "Is it your men in the common walks of life," said Mayor Swift, of Chicago, quoted in the Arena, April, 1897, p. 716, "that demand bribes and who receive bribes at the hands of legislative bodies or of the Common Council? No, it is your representative citizens, your capitalists, your business men." I venture to add that the mayors of most American cities could duplicate the same experience.

† Dr. Andrew D. White has put the number at ten thousand and five hundred. He shows that it has been increasing with frightful rapidity of late years. How shocking has become the disregard of human life among people not belonging to the criminal class, may be gathered from the mobbing and murder of Chinese in the West, and from the practice of lynching, which has extended from the South to the North. Equally significant is the statement of the leader of the Florida House early last May, on the Governor's message relative to lynching, that the Southerner would always summarily punish any person guilty of criminal assault. Referring to "the unwritten but binding law of the land" which allows "a

a kindred nation that has their own institutions and their own love of freedom; that show contempt for the law of nations in their reckless clamor for the recognition of insurgents that have no status as belligerents; that lust after the territory of a primitive people and applaud the conspirators that rob them of their rights; that join with others to crush the native government of harmless tribes of South Sea islanders; that hide behind the dazzling shield of "manifest destiny" colossal schemes of aggression all over the world, and prepare for them with lavish expenditures upon a powerful navy and a vast system of coast fortifications.* Yet it is supposed that a people thus tainted from top to bottom with the ethics of feudal barbarism may be trusted with their brother's keeping—that he can have no possible need of the kindly attention of a good Samaritan.

V.

From democracy as a form of political government no more need be expected than from any other despotism.† Like the government of the one and of the few, the government of the many tends to crystallize society and to thwart its growth. Every law to restrict freedom and every official appointed to enforce it are steps toward a fixity of structure that will cramp and deform social life and divest it of variety or interest.‡ Already this

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husband to slay the man who has invaded his family," the Atlanta Constitution said two years before to a month, "We know it is a bad thing for one man to kill another, but it is worse to permit men to violate the sanctity of a home, and go free upon paying a fine or damages." With an extension of this law of revenge society would soon be reduced to a state of anarchy.

* In a review of one of Captain Mahan's laudations of naval barbarism, in the Political Science Quarterly, vol. ix, p. 172, Mr. Theodore Roosevelt, a brilliant representative of the spirit of modern barbarism, says: "We need to have the lesson taught again and again and yet again, that we must have a great fighting navy, in order to hold our proper position among the nations of the earth, and to do the work to which our destiny points." As though our "proper work" did not consist of strict attention to our own affairs, to the suppression of crime and the better enforcement of justice, to the reclamation of our cities from misrule and to the protection of our liberty from threatened destruction; as though "a great fighting navy" as well as a great fighting army could point to any other "destiny" than the indefinite postponement of this important work of civilization.

† M. Edmond Scherer's study of French democracy has brought him to a similar conclusion. "Je me persuade," he says, in Démocratie et la France, p. 2, "que la nature humaine restera eternellement assez semblable à elle-même, et dans tous les cas, que ce ne sont pas des formes de gouvernement ou des mesures d'économie sociale qui la modifieront."

‡ "It is not by wearing down into uniformity all that is individual in ourselves by cultivating it and calling it forth within the limits imposed by the rights and interests of others," says Mill (On Liberty, Ticknor & Fields edition, p. 121), "that human beings become a noble and beautiful object of contemplation; and as the works partake of the character of those who do them, by the same process human life also becomes rich, diversified,

tendency toward a rigid bureaucracy, with its moral perversion and industrial paralysis, has become painfully manifest. The centralization of the Federal Government, which set in so irresistibly with the civil war, has spread like a pest to the State and municipal governments, which wield an authority over the individual far in excess of the fears of the fathers. The same spirit has entered political parties and reduced them to powerful mechanisms almost military in perfection and despotism. It has seized upon the laboring man and capitalist, and arrayed them in bitter enmity and bloody conflict. It has reached the trades and professions, and developed in them the most odious traits of intolerance and monopoly. It has invaded social life even. There it has created a multitude of organizations with an exclusive and aggressive temper and a feudal love of pretension and show.* When a nation falls, like another priest of Apollo, into the strangling coils of such a system of organization, every part of which is made firm and unyielding by some law in violation of right or in concession of privilege, it has reached the limit of evolution. Immobile and unprogressive, its people, grown greedy, deceitful and barbarous,† lose the capacity to think or to care for themselves. The Government, also become depraved and incapable, degenerates into a huge machine to oppress and exploit. Thus a free democracy is turned into a Roman or Bourbon despotism that only a shock like an irruption of barbarians or a terrific explosion like a great revolution can awaken and rescue from the lethargy of death.

But from democracy as a condition of freedom under moral control, every achievement within the reach of human effort may be expected. Under its *régime* society remains fluent and mobile,

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and animating, furnishing aliment to high thoughts and elevating feelings, and strengthening the tie which binds every individual to the race, by making the race infinitely better worth belonging to."

* I refer particularly to the Colonial, Revolutionary, and Grand Army societies, and to various uniform and semi-secret orders. Referring to the recrowning of the "Queen of the Society of Holland Dames of New Netherlands," a paragraph in a daily newspaper says, "Almost royal state will be attempted, the lady riding on coronation day from her home to the Waldorf in a stately carriage drawn by six white horses, and bedecked with orange-colored ribbons and flowers." Everybody will recall the interest aroused by the exclusion from one of these societies of a descendant of Benjamin Franklin, on the ground that his relations with women had not been above reproach. For a further account of the Colonial societies, see Ladies' Home Journal, July, 1897, p. 10.

† Evidence of this spirit is to be found already in the various trades and professions that seek protective legislation, and also in the testimony of the tariff beggars before the Ways and Means Committee last winter. They show hardly more consideration for their victims than would a wolf for an infant it had found playing in its path. People really civilized could never have permitted the legislation that threw thousands of Welsh tin-plate makers and Austrian button makers out of employment subsequent to the enactment of the McKinley bill in 1890.

ready to assume the countless forms that meet the ever-changing needs of human life. There is no interference with either the law of evolution, which is left to work its miracles, nor with the law that merit shall be the measure of benefit. Subjected to their powerful stimulus, the individual, neither cramped nor plundered by an ignorant and greedy bureaucratic despotism, is impelled to make the most of his talents and opportunities. He is free to struggle and experiment with himself and with the world in every direction. Not protected from the evils of his blunders by an unwise philanthropy nor deprived of the fruits of his successes by confiscatory taxes, he learns to avoid the one and to strive for the other. What is beyond his own achievement he induces his fellows to help him achieve. Whether the object be one of personal profit or public benefit, that alone is the true method. It is the method that will enable men to execute the most important commercial enterprises, like the construction of canals and railroads, and to work out the weightiest moral reforms, like the abolition of intemperance and the mitigation of cruelty. It was the method of the founders of the great religious orders of the middle ages; it is the method of the founders of the great church and secular societies of to-day.* The modern industrial system, unparalleled in history, had the same origin. Not only without the aid of statesmen, but often hampered and almost crushed by their vicious meddling,† its founders have turned forests and deserts into farms and gardens, covered continents and seas with lines of transportation, and filled cities with markets, banks, and exchanges. Thus are avoided the evils of every form of despotism. There is no longer the incentive to practice the ethics of war. No one is forced to surrender his liberty without consent, or to part with his property except by gift or contract. Nor is he obliged to change his thought‡ or mode of life at any behest but that of persuasion and conviction.

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* Note the Epworth League, the King's Daughters, and the Young People's Association of Christian Endeavor. Note also the League of American Wheelmen and the savings and loan associations.

† "No great political improvement," says Buckle (History of Civilization, vol. i, p. 272), "no great reform, either legislative or executive, has ever been originated in any country by its rulers." Even in our own country Congressman Loud made a desperate but futile attempt to reform the postal service and to turn the constant deficit into a surplus. The perpetuation of the seed-distribution evil, despite the efforts of Secretary Morton, is another example of the tenacity of the same trait of bureaucratic despotism.

‡ Everybody is familiar with the intolerance of ecclesiastical despotism; but the intolerance of political despotism is not so much thought about, especially under popular governments. I do not refer altogether to the intolerance of trade unionism nor to that of party organizations, nor even to that of both to foreign immigrants, which are very marked in the United States and sufficiently significant of retrogression. I refer more particularly to the intolerance that denounces the teaching of free trade in colleges and universities; that

Whatever power may be needed beyond the conscience of men to control their conduct will be that of rational public opinion. As a matter of fact, it is the only power at any stage of social progress that has validity or efficacy. Without it neither the autocrat nor the democrat can command the slightest allegiance. But no truth is more persistently and disastrously ignored. Although public opinion can make dissent from a Hebrew myth or from a rule of evening dress more culpable than the deception of a customs collector or a tax official, modern social reformers put their faith in a power that has no authority without it. Instead of appealing to Cæsar himself, who alone wields the scepter, they appeal to Cæsar's slaves, who obey his will and incline to his vices. But every act of a legislator that abridges a right or confers a privilege twists the convictions and perverts the morals of every person affected. As this despotism grows, no matter what name it bears, public opinion becomes more depraved and less fitted to be the arbiter of social welfare. It sets up false standards of belief and conduct.* In the end it will justify bribery and plunder, as during the degradation of the Swiss,† and even assassination, as

excludes from such institutions, as in Kansas, the professors that oppose populism; that requires an official history of the civil war to be taught in the public schools. Should wheat production and distribution become a function of the Government, I doubt not that prescribed or "official" views in regard to it would spring up, as in regard to the tariff and the currency, and that instruction in them in all State institutions would be demanded. Still another amazing example of intolerance is to be found in an article from the Democrat and Chronicle (July 2, 1897) of Rochester, N. Y., the largest and most influential Republican newspaper in the State outside of New York city. "A college president," it says, exhibiting the same spirit as that of the measure before the Prussian Diet to suppress critics of the Government or of Prussian institutions, "ought to have full power to drive out by force and arms, if need be, college professors who belittle American history and cast reflections upon our system of government. In recent years some of the colleges have become teachers of pessimism in history and politics, sending out narrow-minded critics of American institutions. A correspondent of the Sun, E. A. Scribner, a graduate of Bowdoin, suggests a chair of 'American Patriotism' in every college. There is need of such a chair in several institutions."

* How far public opinion has been perverted in the United States by this influence may be gathered from an address of Dr. Rainsford before the Woman's Auxiliary to the Civil Service Reform Association, reported in the Evening Post, May 6, 1897. "Dr. Rainsford," it says, "administered a scathing rebuke to those who excuse corrupt practices on the part of politicians and others in power on the ground of expediency. Educated men who accepted such things as necessary evils were the most to blame, and committed the greatest crime against democratic institutions. He thought that the distrust manifested in some quarters arose from the fact that the country was honeycombed with the idea that 'pulls,' 'deals,' buying of legislation, and similar practices is the only way to get things through. Continuing, 'I heard a member of the City Club declare that it was legitimate to buy legislation at Albany.'" I, too, have heard respectable men express the same opinion.

† "La corruption par l'or étranger pénétra chez les députés aux diètes fédérales: l'assentiment des peuples dans les cantons fut obtenu par des dons annuels décorés du nom des pensions." (Morin, Histoire politique de la Suisse, vol. i, p. 101.)

after the collapse of the Italian republics.* Thus, without banishing the devils of freedom, the reformers, moved to such endless efforts to keep swept and garnished, evoke only the devils of despotism, which are immeasurably more ferocious and destructive.

A TORTOISE-SHELL WILD CAT.

By WILLIAM H. BALLOU.

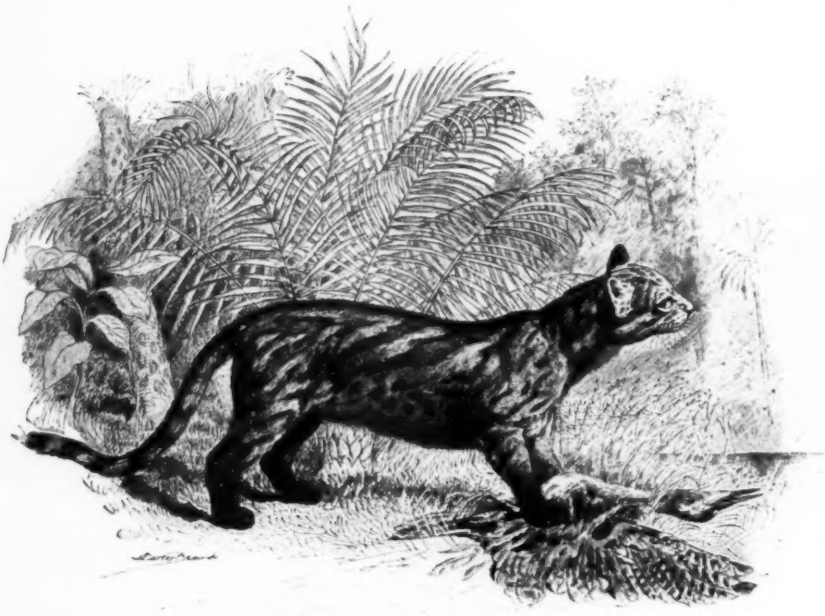
THE cat family has given naturalists quite as much trouble as it has the ordinary citizen in his efforts to repose at night. The wild type (or types) of the domestic animal has never been located, although various views have been advanced to account for the household pet. As far back as we can distinguish man arising on the horizon of history, we find him accompanied by certain domestic animals, the origins of which are quite as involved in problems of transition conditions as is man himself. The late Dr. J. S. Newberry was wont to exhibit to me a mummified alleged cat from Egypt, to show that the domestic animal of the Egyptians was really a civet. The late Prof. Cope thought that perhaps all living species of wild cats had been defined, until *Felis bracatta* was sent him from Brazil; he thought it probable that there were no more extinct *Felidæ* to be discovered until, just before his death, a pocket containing several new types was opened in a Philadelphia quarry not far from his laboratory.

I have always taken an interest in the origin of the domestic cat, not the least diminished by these two lamented paleontologists, who could find no technical basis for any theories that have been advanced. No wild cat has been tamed in modern times, and years of confinement and kindness have wholly failed to soften the savage nature of these denizens of the forest and jungle, some representatives of which will instantly attack man or beast, oblivious to overwhelming odds, and fight to the last gasp. I have always inclined to the multi-origin of various types of domestic cats, holding that wild types in various parts of the earth gave origin to the domestic types therein found. It is impossible for me to reconcile to a common existing wild ancestor the domestic cat of the Isle of Malta, the stub-tailed Manx cat of the Isle of Man, and the tortoise-shell cat of Brazil—all well-known domestic types.

It was therefore with great interest that I viewed in the late

* "Tyrannicide was extolled as a patriotic virtue. . . . Public honors were paid to Donatello's statue of Judith the tyrannicide, erected in Florence, with the inscription '*Exemplum salutis publicæ cives posuere!*' While such a spirit prevailed in society, tyrants lived in constant dread of assassination." (May, Democracy in Europe, vol. i, p. 323.)

Prof. Edward D. Cope's laboratory at Philadelphia, during the past winter, the *Felis bracatta* from southern Brazil. The size of the animal is that of the domestic type, and its coloration is very near to that of the tortoise-shell pet. Prof. Cope would tell you that its only structural resemblance was to that of *Felis jaguarondi*, a common Brazilian wild cat of similar size. It would seem that color and size might be at least suggestive, when structural variation might possibly be accounted for by long years



FELIS BRACATTA (Cope). Southern Brazil.

of domestication, changes in environment and food. But this is mere theorizing, an approach to venturesome ground, of which the paleontologist has a natural horror. At another time and in another article I propose to point out certain interesting resemblances between types of domestic and types of wild cats, even at the expense of being criticised by my friends who stand by teeth, skull, vertebræ, and claws. I propose to assume that the ancients had patience and good methods of reducing wild animals. The origin of the cat is as much of a mystery as the north pole, and entitled to the same venturesome exploration. Paleontology can throw no light whatever on the domestication of animals. Zoölogy has so far rendered no material assistance.

Only one specimen of the new Brazilian wild cat is in existence. Not long since Prof. Cope found the skin in a musty old box, where he had labeled it *Felis bracatta*, and hurriedly placed

it long ago. He had this skin mounted, and the new work of taxidermic art became a favorite on his wide writing desk, together with the skull of a primitive Japanese, the femur of a camarasaur, a live Gila monster, and a live turtle. The bracatta was found in the great forests of southern Brazil. Its chief value lies in the fact that it is the only specimen in existence, and modern values are based on the rarity of the commodity. Bracatta has a protective advantage in its colors, which are such that it would scarcely be distinguished, even in motion, from the dead leaves, soil, or rocks, accounting for a ready escape from enemies and an easy capture of prey, presumably small birds and mammals. Its general color is brown and shades of brown, suggestive, on the whole, of tortoise shell. The shading extends obliquely down the back toward the hind legs. The hair is long and very fine. The beautiful, dark, striped tail is nearly the length of the body, exclusive of the neck. Underneath the cat is spotted after the manner of leopards, and the legs have dark bands and boots. It is a slender, tapering, and graceful animal. Its markings are plain, suggesting the beautiful in simplicity, which aid in its general harmony with surroundings and to conceal it from the eye. It has black and gray ears of moderate size, with long inside hairs of a buff color. The whiskers are long and buff-colored, with black bases. Below each nostril and above each eye are buff spots; the cheeks are yellowish brown; the chin is a pale buff, and the throat has three rows of brown spots; the tip of the tail is black; the feet are small.

Prof. Cope pronounced the animal new to science because it was allied to only one species, *Felis jaguarondi*, and was possessed of characters which appeared to him to be distinct. The jaguarondi is a wild cat of similar size from the same locality, but its structural differences are notable. These structural differences are visible at almost every point of comparison, applying to feet, toes, claws, tail, ears, fur, and coloration. The aggregate of these characters indicates the specific differences.

Accompanying this article is a drawing of the bracatta as he probably appeared in life and environment. A mounted skin is necessarily more or less contracted and distorted. I think, however, the artist has effected the proper catlike proportions and markings with much fidelity to Nature.

It will be noted that the harmony of all this coloration is best expressed by the general term of tortoise shell. Its love of small birds and mice further suggests the domestic cat. Perhaps future capture of the species and a study of its habits in the wild state may disclose its relations, if any, with the tortoise shell of the fireside. At least it has the merit of being the nearest approach yet found to this particular domestic type.

ANTHROPOLOGY A UNIVERSITY STUDY.

By JOHN S. FLAGG,

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ANTHROPOLOGY, the science of man, has been in the past a term of comparatively narrow significance. Journals of anthropological societies all show a habit of thought along a few restricted lines. Under the old scholastic *régime* the departments of archæology and written history comprised nearly the sum total of anthropological study, all other studies appearing to be related, though but slightly, in a fixed cosmogony. Later, ethnology, as a truly scientific study, apart from history and comparative philology, has crept in as a growing realization of the interdependence of all knowledge arose.

The marvelous results of scientific investigation with which the workers of this century have blessed us, and above all the far-reaching generalizations which great but exact minds like Darwin's and Spencer's have given us, have so unified scientific thought that the student has been obliged to enlarge his use of the term anthropology to embrace the new and broader concept. He now realizes that every department of study is necessarily a department of anthropology, in that every branch of knowledge has some contribution to make toward the solution of that greatest of all problems to us, What is man—how did he originate, and how arose his characters and customs? As it was realized that man was a result of all precedent causes that had acted in his line, and as no activity, however remote, but had some effect on this line, either mediately or immediately, the concept became ever larger, until now the term anthropology really conveys the idea of a broad synthetic philosophy, built up from verified and ever-verifiable data alone—the great law of the evolution of all things and the harmonious mass of laws relating to detail, which shows the universe a logical series of causes and effects. While each separate department of science is busy adding new data to the mass of detail, correcting by careful and constant verification and a juster appreciation of values the false concept that some previous fact has given birth to, anthropology fits each new fact, so far as it bears on the problem of man, into its proper place in the whole; sees hitherto unknown relationships to facts discovered in other lines of research; traces further and further through the web of things the warp threads of unvarying law. As the master builder carries within his mind the concept of the finished building, to whose realization every workman contributes by adding each his stone, so a perfect anthropology can be real-

ized only by the contribution of every fact dug out by tireless and devoted research, fitted together by workers equally tireless, equally devoted. Isolated facts are of little value for the advancement of human knowledge; it is only when correlated—brought into their proper relationship to other data—that they are able to yield their full quota of aid.

For more than two thousand years speculative philosophy has dominated the schools, and in all that time has made no actual advance toward explaining the nature of man or his relationship to his environment.

Tied to the ever-varying and unverifiable personal equation, there could not be a sound basis for a worthy superstructure. It was not until Herbert Spencer, taking as the basis of his deductions those objective activities from which alone the subjective states of another can be judged, reared his splendid synthetic philosophy, which is destined to supplant all others as a system, even if every detailed deduction made by him were disproved.

If anthropology, then, comprises every department of human learning, it might seem that a university is as a whole devoted to the study of anthropology, that its various departments are branches of this one universal study. Were universities ideal institutions of learning, and had they been reared at once on a true scientific basis, this might be so. Then, again, anthropology views the details of each branch of research chiefly with reference to its bearing on the evolution and present status of man, while the active specialist as an earnest searcher for truth must wrest from the unknown each minutest fact in his own domain.

Were a university curriculum arranged on a perfect scheme of anthropological unity, the time at a student's disposal would not permit him to gain any adequate acquaintance therewith. Desirable as it might be to have a university founded on such a scheme of logical unity, yet it would fail in giving the student a complete grasp of the interdependence of all phenomena through its very multiplicity of detail.

As our universities are constituted, where is there one that has a definite curriculum so arranged that its various departments bear any true relationship to the whole, whose scheme of training is so arranged that there arises in the student's mind any conception of unity?

The very requirements for admission and the consequent training furnished by the preparatory school are based almost wholly on the old scholastic mode and Platonic cosmogony. The minor colleges, having set courses, are still controlled by the same influences. The larger colleges, having professional schools attached, and aspiring to the broader title of universities, pile all the intel-

lectual food on the table at once, and the hungry rush in and help themselves to whatever is within their reach, and come away at least self-satisfied. The few minds that are synthetic either by nature or early training are those that reap the highest good; the rest have at most sharpened their wits or gained a pert self-esteem, while many are unfitted for a life of action.

Ingersoll's brilliant sentence in his Lincoln lecture has not a little truth in it: "Colleges are places where pebbles are polished but diamonds are dimmed." The truth that lies in this sentence will be true so long as colleges remain a series of parthenogenetic scholasticisms unfit to cope with the hard environment in which mankind must live.

Our higher schools have in the past had to deal with only a limited and favored portion of mankind, but with each succeeding generation of students they have had to go down deeper among the producing people, and at each succeeding stage they have more or less closely reflected the general average of those with whom they dealt. People, colleges, and civilization have all evolved together, *pari passu*. Just now all are in a state of transition. In the colleges even scholasticism is slowly giving way before the assaults of exact knowledge. One is encouraged at seeing the rapid increase of laboratories, and the lengthening courses in English and economics, and the diminishing proportion of time devoted to the classics. Would that one might say the same of speculative philosophy! Its value as now studied, save as an exercise in mental gymnastics, was aptly characterized by one of the best-known professors of philosophy in this country, when he said to me, "Philosophy is wind, and he that can sell his wind at the highest figure is the greatest philosopher."

The history of the growth of philosophic thought, studied as a branch of anthropology, is of value, as the history of the slow growth in any other department of human thought or effort is valuable—no more.

The real value of anthropology, then, as a university study is to take the place that philosophy occupied in the old scholastic system, save that synthetic philosophy, under whatever name, requires a broad basis of accurate knowledge. He that would teach must have a mind of largest grasp, capable of far-reaching generalizations, rigidly ruled by absolute fact. To this end preliminary training in exact investigation is indispensable, that he may be familiar with the road to truth and readily detect the verified from the speculative. On the other hand, he must not be a mere delver for facts. Men who are justly noted as investigators are constantly proving themselves unfit for generalized deductions even in their own departments. The teacher of anthropology must be accurately acquainted with results in astron-

omy, geology, paleontology, biology and embryology, ethnology and archæology, philology, sociology, and economics.

Above all, he must be a devoted lover of truth and unwavering in its search. He must never be led away by an unsupported theory, however seductive.

It has been said in the past that great men make great men, that the influence of a great mind on plastic youth is invaluable; and it is as true now as ever. But the concept of what makes a great mind has changed. In an age of scholasticism, with an almost universal adherence to a fixed cosmogony, that man was great who by his personality and the influence that it carried could transfer that cosmogony as a whole to the minds of his pupils and the code of its ethics to the guidance of their lives. It is one of the glories of the new scientific thought that there can be no completed cosmogony, that it is ever growing and being rectified with each new truth discovered. The example of noble men of the past and the study of their deeds may stimulate others to live like them still. But for building up a stable character, the baseless, shifting philosophy of the past can never equal the study of exact truth as expressed in natural law and the humble facts of our own being. Nature never lies to her children if they stop and listen. There is more rigid, unprevaricating response to an honest query in a right angle than in all the sophistry of the schools. The young man that is thrust out into the world of action now, with only the scholastic cosmogony as a support for his moral code, is to be pitied when he finds his foundation swept away, as it surely will be if he truly thinks. How much more sturdy he would have been had he been led to clearly see the social necessities that step by step gave rise to moral law—law that grows higher and broader with social need and raises ever to its own level its own creators!

A QUITE original system of raising revenue is described by Mr. Hugh Clifford as existing in the Malay state of Trengganu. "It is managed in one of two ways. Either a consignment of goods is sent to the village or to an individual, and a price considerably in excess of that current in the markets is demanded in return for them; or else a small sum of money is sent, and a message is conveyed to the recipients that a given quantity of *getah* or jungle produce is demanded in return. On the receipt of a *serah* a village headman calls his people together and enforces a public subscription to meet the sum required by the *raja*. The things are then divided among the subscribers, but as the quantity of goods is altogether out of keeping with the high price paid for them, and as the village elders usually insist on receiving the full value of their subscription, the weaker members of the community get little or nothing in return for their money." The other form of assessment likewise works oppressively upon its victim.

STONES IN THE HEAD.

By Dr. A. CARTAZ.

IN all times painters have been fond of reproducing scenes of medical life, but the tendency has never been more marked than it was in the middle ages. Taking to the very life the oddest-seeming subjects, they have presented with the hands of masters the realistic pictures of the most various nervous troubles and pathological afflictions. On celebrated canvases may be seen, in attitudes of the most scrupulous exactness, the likenesses of great nervous affections like hysteria, malformations, clubfoot, and rickets. The great book of Charcot and Richer, *Les démoniaques et les malades dans l'art* (Demoniacs and Invalids in Art), has brought out into the light the large number of ancient works in which scenes of that kind are to be found. Yet they deal with only one special point in pathology.

A gentleman whose artistic erudition is equal to his medical knowledge, Dr. Henry Meige, has in his turn been gleaning in a rich field for observations, and has given us, in a series of remarkable studies in the New Iconography of the Salpêtrière, a sagacious and interesting critical estimate of the "painters of medicine." A recent memoir of his concerns pictures illustrating operations on the head.

We find these scenes of medical life most frequently reproduced, whether in a realistic or a satirical fashion, in the Flemish and Dutch schools. There are pictures giving a vivid image of a woman dying of hydropsy of the heart, as in Gerard Dow's celebrated canvas in the Louvre; of a young victim of anæmia, as in "The Patient" of Van Hoogstraaten, at Amsterdam; of a hysterical sufferer, as in "The Possessed" of Rubens, etc. But these pictures are most frequently figures of charlatans and really caricatures; subjects were abundant, for in that day, as in our own time, quacks and tooth-pullers were not idle. As in our fairs and parades, street operators and doctors and quacks of all sorts made display of their knowledge in public, and their address was not lacking in wit or warmth. Such scenes as these the Flemish painters strove especially to represent, castigating the quacks with their satirical pencils.

The pictures which we present to our readers repeat scenes from the operations for stone in the head. It may be asked, What was the operation which the painter intended to ridicule? There exist on the hairy part of the skin no such calculous products as are found in the canals of some of the glands or in some of the reservoirs of the organism, like the biliary vesicle or the bladder. We only know as tumors that might lend themselves

to the operations of wandering quacks or mountebanks, such as the pictures represent, the sebaceous cyst or the common pimple, the caseous contents of which may possibly become chalky and hard like a stone. There are also pimples scattered over the forehead and the cranium which may be freed from their cores by a stroke or two of the bistoury. Large operations on the head were certainly known in those days; for trepanation, with which Hippocrates was acquainted, goes back, as any anthropologist will tell us, to prehistoric times. But our quacks could not have become skillful in such bold attempts; and if they had

FIG. 1.—"STONES IN THE HEAD." An engraving from the picture of Pierre Brueghel le Vieux, in the engravings room of the Amsterdam Museum. (Flemish school of the sixteenth century.)

only pimples to remove, there would have been no need of making a triumphant display of a stone or of piles of stones.

In his very judicious interpretation of these pictures, Dr. Henry Meige concludes that they relate to operations which were for the most part purely factitious and addressed to subjects of disordered minds. Instead of talking of bees in their bonnets, they said in the fifteenth and sixteenth centuries of persons a little off the balance that they had a stone in their head; and if one of such unfortunates happened to recover, they said, just as carelessly, that a stone had been taken out of his head.

When such a way of talking was current with the public, what is there to surprise one that the quacks of the period should be on the lookout to make innocent and half-witted persons believe that they were masters of the surest process to cure them of

their terrible infirmity? Do we not see in our own time patients persuaded that a snake is devouring their insides, that their skull is bored with a gimlet? Do we not see simple maniacs possessed by like ideas? Are there not neurasthenics who have a helmet weighing upon their head and compressing their brain?

FIG. 2.—"STONES IN THE HEAD." Picture by Jan Steen. Boijmans Museum, Rotterdam.

Have not hysterics their famous nail? And would not all these people of those times, less cultivated than in our time, however high their position may have been, be willing, in the paroxysms of their suffering, to submit to any operation that might be suggested in order to be delivered permanently? It was so formerly, and more especially in the era when sorcery had lost none of its prestige. It therefore seems logical to us to regard these operations, as Dr. Meige does, as pure deceptions of quacks; furthermore, we have the pictures to prove this.

Let us look, for example, at the painting of Brueghel le Vieux, in the Amsterdam Museum (Fig. 1). We are in a busy doctor's shop, where operations are performed without truce or mercy. Three surgeons are not too many to attend to the throng of patients. One rustic, already operated upon, looks slyly at his neighbor who is howling with pain and pushes away the assistants, while the operator is preparing, with formidable-looking forceps in his hands, to extract the troublesome stone. On the right, another operator, his head covered with a queer-looking long cap, is opening the incision through which deliverance is to come. In the background, an assistant is practicing upon a corpulent old fellow, while a fourth is trying to retain an unfortunate who is

making for the door. These scenes of pain make no impression upon the monks, one of them prostrate and exhausted and carried by a good rustic who salutes the company with his fur cap, while another is exhibiting his affliction and asking for deliverance from it.

Another design, likewise by Brueghel le Vieux, is still more suggestive. It is a bald caricature, directly aimed against the quacks. The scene is not laid in a shop, but in the open air, with a staging put upon barrels, on which the operator (alone this time) exercises his wonderful talent. The crowd is gathering around him, presenting a curious series of types; some gaping with astonishment, some frightened, and others rejoicing as if at the approach of deliverance. One unfortunate has just passed through the hands of the operator; an assistant is applying a restorative liniment to the open wound, while the victim is gazing sadly at the pebble which is supposed to have been taken from his head. Another one is about to be placed in the fatal chair; the surgeon with his lantern carefully examines the offensive body. The patient howls, but a matron holds his head firmly. Another one is being brought up with a tumor larger than an orange on his head. Hidden under a stool is a confederate with a basket full of stones, ready to be passed at the proper moment, as the ball is passed to the juggler—and he is a confederate who can be relied upon, for his lips are closed by a padlock to secure his silence. The satirical intention of this curious picture has been marked by the painter himself in the little sketch outside of its lines on which he has placed his signature. It is a large egg containing an operator and his victim, with stones raining from the patient's head and falling out of the shell.

FIG. 3.—"STONES IN THE HEAD." Picture by van Achen (van Bosch). Amsterdam Museum. (Dutch school of the sixteenth century.)

A like satirical intent may be found in Jan Steen's picture (Fig. 2), although the scene is treated less fancifully. The operator may have been a well-known man; he does not operate in a

public place, but at home, in a comfortable Dutch interior; but he is not without skillful accomplices—the matron, his habitual assistant, with her cunning expression, and the urchin who laughs at the humbug of the thing, as he passes the pebbles which the crafty charlatan causes to roll over the neck of the suffering patient.

The scene represented in Jerome van Achen's picture (Fig. 3) would be considered less grotesque were it not for the fantastic dress and appearance of the operator; his robe, his cap, down to the curious stool he stands upon—all are extraordinary. The quiet figure of the patient is no less so. Surely, if any such stones had been taken from his head as the other doctor is showing to the assistants, it must have been with the aid of a local anæsthetic. He beams with as happy an expression as if a most grievous pain had just gone away from him by enchantment.

M. Meige has collected more than a dozen pictures representing these operations for stone in the head.—*Translated for the Popular Science Monthly from La Nature.*

A LILLIPUTIAN MONSTER.

By ROBERT BLIGHT.

IN front of a sunny window there stands, on a small bamboo table, an aquarium of very unpretentious appearance and size. It is nothing more than a "globe," such as is used for goldfish. In the bottom are a couple of inches of river sand, with a thin layer of gravel, which was repeatedly washed before it was placed there. Planted in the sand is a plant of water starwort, as well as one of anacharis, while on the surface float a few plants of duckweed; and two or three water snails complete the arrangement. Around the rim of the globe is tied a string on which is threaded a screen of dark-green material, which can be drawn so as to shade the globe or to admit the sunlight at pleasure.

Occasionally I amuse myself by fetching a pailful of water from the stream that runs through the meadows; and as I take up the water I give the grass and water weeds a good shake to get whatever creatures may be hiding there. I have provided two pieces of glass tubing of equal diameter—one about two feet in length, the other only some fourteen inches; and these I have bent nearly double by the heat of a spirit lamp. Thus equipped, I change some of the water. I place a footstool or a pile of books covered with a newspaper on the table, so as to get a surface as high as the top of the globe. On this I place a "Mason jar,"

borrowed from the kitchen, filled with the water from the stream. By the side of the globe I place another jar, empty. Taking the shorter tube, I place one end in the aquarium and give a quick draw with my lips, slipping the end instantly into the empty jar. As soon as I see that the water is flowing through the siphon I repeat the operation with the full jar, and, as the leg of the siphon is sufficiently long, the water runs from the jar into the bottom of the globe. Thus a current is set up in which the plants wave back and forth, and from the liveliness of

FIG. 1.—HYDRA VULGARIS.

the living creatures it is evident that they enjoy the sensation. When I see that the upper jar is nearly empty, I remove the siphon from the lower one, and the replenishing of my "tank" is at an end.

Few can tell how much pleasure is obtained from this apparently trifling "hobby," but it really is intense. Close at hand is the microscope, and on the table, ready for use, lie a piece of glass tubing for a pipette, a zoöphyte trough, a pair of forceps, and an ordinary pocket magnifier. It is easy, when anything is

wanted, to take it out, either with the pipette or the forceps, and transfer it to the trough. By holding it up to the light one can readily see whether it is worth while to sit down at the other table and use the much more powerful aid of the binocular microscope.

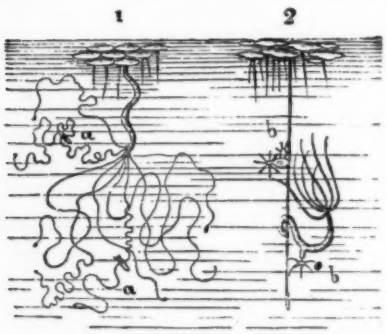

FIG. 2.—THE FRESH-WATER HYDRA HANGING FROM DUCKWEED IN A POND: 1, the long-armed hydra (*Hydra fusca*) feeding; *a a*, small animals caught in its arms; 2, short-armed hydra (*Hydra viridis*) throwing off young hydra buds, *b b*.

My friends, it is true, laugh at me, and I laugh at them. They wonder why I am so devoted to "a glass globe full of water, with a few plants and snails," and I tell them that while they see much to admire in horticulture, agriculture, and a host of other "cultures," I am an enthusiast about hydra-culture. Indeed, in this small and insignificant aquarium I have a flock of fresh-water polyps, called "hydras," full of interest, full of wonder. I envy Trembley, who in 1744 published A Memoir on the Fresh-water Polyp, the intense pleasure he felt in unraveling the life history of these creatures. He was investigating the unknown when he studied the strange phenomena connected with them, and was transported with astonishment. I know, from the labors of others, what to expect, and yet I am lost in wonder.

We may be thankful that these animals are as small as they are; for, if they were only a few feet in length, we should have in our water world many a repetition of the devastation said to have been caused by the Lernæan Hydra, whose destruction was one of the gigantic labors of the hero Hercules. As it is, the longest you can find is only an inch in length. They can, however, be easily seen with the unaided eye, and with the help of a pocket lens can to some extent be studied. In fact, Trembley, the famous observer of them, had nothing better. It is only when we wish to examine minute details that the use of the elaborate microscope is called for. A group of them attached to the rootlets of duckweed or the under side of the leaves or on the stems of plants is a curious sight. A nearer view may often be obtained, for they will attach themselves to the side of the glass to enjoy the light, which they seem to love.

The commonest species of hydras may easily be distinguished by their color, one being usually a reddish brown, while the other is a vivid green. The particular shade of color of the former depends on the nature of the food captured; and it is said that it has been colored blue, red, and white by feeding it with

matter stained with these pigments. Other species have been noticed, but they are less common, and some are rarely met with.

A single individual may be thus described: There is the body, like a thick thread, of varying length up to an inch. At the foot the substance is slightly expanded into a small disk, with which the creature fixes itself to some surface; at the top is a series of arms or tentacles, thin, threadlike, and arranged symmetrically around the end of the stem, which is the mouth. These tentacles vary in number, the green hydra having from six to ten, and the brown one from seven to twelve. As the trunk sways this way and that in a slight degree, and the tentacles twist about, the sight is a curious one and well worth while watching. The arms have the power of contracting, and sometimes look like little buds around the mouth; and the trunk itself will also sink down until it seems to be a small mass of jelly.

The trunk is nothing but a stomach. There are no lungs, no liver, no heart, no intestines, no nervous system. All there is consists of two layers of tissue, with a very delicate layer between. The trunk and the tentacles are alike in structure, and are simple hollow tubes. If the latter are examined with a magnifying glass, they are found to be covered with little warts, which are technically called "urticating" or stinging organs. These consist of an oval capsule, the top of which is turned back into itself so as to form a cavity in which there lies a thread coiled up, while round the edge of the cavity are four little darts. In this introverted capsule the thread lies bathed in a poisonous secretion, and the darts are nothing more or less than poisoned arrows. The opening is provided with a sort of trigger, so that when any substance is pressed against it the capsule is flung outward, the thread is cast round the opposing body, and the poisoned arrows are projected into its substance if it is penetrable.

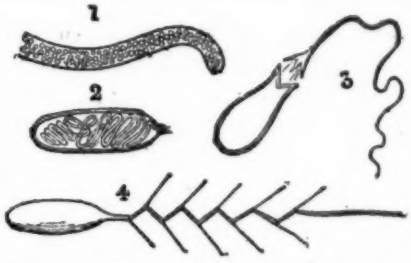

FIG. 3.—LASSO CELLS OF THE HYDRA AND SEA ANEMONE: 1, piece of one of the hydra's arms, showing the cells crowded in it; 2, one of the cells; 3, the same cell after bursting open; 4, lasso cell of an anemone.

The hydra lives on minute aquatic creatures, and is exclusively carnivorous. Attached to its moorings, it spreads its arms in every direction with a searching motion; and although the two commonest forms can not explore at a much greater distance than the height of the body, the "fuscous" species—one of the rare forms—has tentacles which can reach some seven or eight inches. As soon as a victim touches the subtle angling line it is seized by it, enveloped in the threads, and struck by the

darts. Then begins a tussle which generally ends in the captive being conveyed to the mouth. Occasionally some strong swimmer may get away, but, unless he is armor-plated, he has but little chance of his life, for a poisoned dart is most probably imbedded in his body. Sometimes a victim is very troublesome, and, in order to get it safely into its mouth, the tentacle itself must also be partially ingulfed, and it remains so until the morsel is quiet, and even until digestion has begun. As the food is drawn in, you can see the body swell, and in some cases become quite pear-shaped. After a while the swelling subsides, and, after all the useful part of the food has been extracted, the rest is ejected at the same place at which it entered. It is most interesting to watch the instinctive motions of this creature, which is totally destitute of what we should call brain.

Hitherto we have spoken only of a single individual, but we must now notice a startling fact. The hydra is multiplied according to the usual law—by eggs, it is true; but also in another way. You can not examine a group in summer time without finding that they "bud." You see the trunk of one bearing a second, perfect in every respect, except that it is connected with its parent, instead of resting on a foreign substance. It has sprouted out from the parent stock, like a sucker from a tree. It may break off after a while and seek an independent resting place, or it may send out a bud from its own stem, which in its turn may do the same, and all may remain attached for some time. While this connection lasts, each member of the compound body forages at his own "will," but the tubes of each connect with the trunk of the next, and so with the parent stomach. Thus they form a colony in which each member helps to maintain every other member by his labor. A sight of such a colony of hydras, the working of which is visible to the naked eye, helps one to understand many other similar forms of animal life—as, for instance, the corals, which form colonies by budding. As many as four generations of hydras have been seen on one stem, so that there is some reason for likening such a community to "a living genealogical tree."

By a number of experiments with which some of us will scarcely sympathize, Trembley and those who have repeated his investigations have brought out many astounding facts about these animals. If you cut one in two across the trunk, the upper part floats off and resumes its voracious habit in a new locality; while the lower portion remains, develops a new set of tentacles, and goes on just the same as if nothing had happened. Nay, you may cut a hydra into five or six pieces, and each will make a separate animal. If one is divided into two vertically, the two halves close up, and again you have two individuals. Trembley suc-

ceeded also in turning a hydra inside out, and it was able to catch food and digest it as well as before. The creature, however, insisted on turning itself back again, and this was not what the experimenter wished. He therefore passed a needle through the body, near the mouth, and kept it there.

The method of this Dutch naturalist was very ingenious. Holding the hydra in a little water in the palm of his hand, he induced it to swallow a small worm. He then took a bristle and began to push against the base, working the end of the body upward against the worm, and soon had the animal inverted. Thrusting a needle through the base of the tentacles, he had what he wanted. He says: "I have seen a polyp turned inside out, which has eaten a small worm two days after the operation. I have fed one in this state for more than two years, and it has multiplied in that condition."

Hydras have but low powers of locomotion, but still they can move from place to place. When one wishes to go upon its travels it attaches itself to the surface of its support by a tentacle, and then moves the disk up to the tentacle. In this way it can get over about eight inches in twenty-four hours. It can, however, take a longer journey by attaching itself to the shell of a water snail, and thus travel in a few minutes a greater distance than it could do in a day alone. It can also swim with the disk floating on the surface of the water as if suspended.

Although without eyes and a nervous system, the green hydra is very sensitive to the light, and indeed all seem to be instantly aware of a ray of sunlight. Would it not be curious if it was discovered that the rays which affect sightless creatures, like the hydra, are those about which so much investigation is being carried on?

Many more interesting things might be said about hydras, but these must suffice. I will only add that the more I think about them and the more I see of their habits, the more I realize the truth of the words of Charles Bennet, of Geneva, in Switzerland, about them: "We can only judge of things by comparison, and have taken our ideas of animal life from the larger animals; and an animal we can cut and turn inside out, which we can cut again and it still bears itself well, gives one a singular shock. How many facts are ignored which will come one day to derange our ideas of subjects which we think we understand! At present we just know enough to be aware that we should be surprised at nothing."

A PLANT of a new species—*Bauhinia magalandra*—is described as growing on the island of Trinidad, the flowers of which depend on bats for their fertilization. The bat visits the flowers for the insects they harbor, and, in trying to reach them, disturbs the stamens and shakes the pollen from them.

THE ORIGIN AND DEVELOPMENT OF NUMBER SYSTEMS.

By Prof. EDWIN S. CRAWLEY.

IT is generally acknowledged that we have in the number systems of the lower races to-day a means of studying the development of our own system. This is based upon the assumption that when the savage begins to count he does it always in essentially the same way. This is, in fact, more than an assumption. An analysis of the number systems of many races scattered all over the globe shows that such a similarity exists, and there is no reason to suppose that our own ancestors followed any other method. Indeed, such evidence as it is now possible to bring forward all goes to support this view.

Counting begins when man first forms the idea of *two* as distinct from *one* and *more than two*. We may perhaps go back even one step further, and say that it begins when the idea of one, as distinct from more than one, is formed. If this be taken as the starting point, the distinct conception of two forms the second step. It is difficult to realize that such ideas are not contemporaneous with the birth of intelligence, but there is evidence to show that such is not the case. According to Dr. Charles Letourneau, we have one example of a race which has not yet taken even this first step. He says in his book on Sociology (translated by Henry M. Trollope), page 582: "The Weddahs of Ceylon, who seem to be the least intelligent of men, have still no mathematical faculty whatever; they have no name for any number." To say that they have no name for any number probably does not imply that they are unable to realize that one group of objects contains more individuals than another group of the same objects. They could even determine which of two such groups contained the greater number of objects, by placing in succession one from each group in pairs until all in one group were exhausted. Such a process, however, is not counting, and the race which finds it necessary to resort to such an expedient may fairly be said to have no conception of number as such.

We find other races who have taken only the first two or three steps. These are chiefly the South American forest tribes and the bushmen of Australia. Speaking of these tribes, Edward B. Tylor says (Primitive Culture, London, 1871, Vol. I, page 220): "Five is actually found to be a number which the languages of some tribes do not know by a special word. Not only have travelers failed to get from them names for numbers above 2, 3, or 4, but the opinion that these are the real limits of their numeral series is strengthened by their use of the highest known number

as an indefinite term for a great many. Spix and Martius say of the low tribes of Brazil: 'They count commonly by their finger joints, and so up to three only. Any larger number they express by the word *many*.' In a Puri vocabulary the numerals are given as—1, *omi;* 2, *curiri;* 3, *prica,* 'many': in a Botocudo vocabulary—1, *mokenam;* 2, *uruhú,* 'many.'" It is needless to multiply these examples.

The next step in advance in the development of a number system is taken when the fingers and toes are brought in as aids in the art of counting. The advance is now comparatively rapid up to the point where, these means being exhausted, there is no further natural aid conveniently at hand. It is popularly believed that finger-counting represents the very earliest stage of the art, but the existence of tribes who can not count as far as five, as already cited, would seem to be conclusive evidence of a stage which antedates this. The etymological character of the numeral words in most of the known languages points to the same conclusion. Prof. Levi Leonard Conant, in a book recently published under the title The Number Concept, has collected and analyzed a great number of the numeral systems of savage and semicivilized tribes. He says (pages 98 and 99): "Collecting together and comparing with one another the great mass of terms by which we find any number expressed in different languages, and while admitting the great diversity of method practiced by different tribes, we observe certain resemblances which were not at first supposed to exist. The various meanings of 1, where they can be traced at all, cluster into a little group of significations with which at last we come to associate the idea of unity. Similarly of 2, or 5, or 10, or any of the little band which does picket duty for the advance guard of the great host of number words which are to follow. A careful examination of the first decade warrants the assertion that the probable meaning of any one of the units will be found in the list given below. The words selected are intended merely to serve as indications of the thought underlying the savage's choice, and not necessarily as the exact terms by means of which he describes his number. Only the commonest meanings are included in the tabulation here given:

"1 = Existence, piece, group, beginning.
"2 = Repetition, division, natural pair.
"3 = Collection, many, two-one.
"4 = Two twos.
"5 = Hand, group, division.
"6 = Five-one, two threes, second one.
"7 = Five-two, second two, three from ten.
"8 = Five-three, second three, two fours, two from ten.
"9 = Five-four, three threes, one from ten.

"10 = One (group), two fives (hands), half-a-man, one man.
"15 = Ten-five, one foot, three fives.
"20 = Two tens, one man, two feet."

One of the most significant things to be observed in this table is the absence of any reference to the figures in the numerals for 1, 2, 3, and 4. This strongly confirms the view already expressed, that counting began before the use of the fingers as an aid was thought of. The higher numerals, on the contrary, are made up almost entirely of finger-words and their adjuncts. This does not appear in the English translations, but in the original words it is seen at once.

We may say, therefore, that the human race in learning to count passes through three stages. In the first stage the fingers are not used; progress is very slow; no distinct conception of numbers greater than two or three is formed; all beyond this is "many." Indeed, in this stage it is altogether probable that no conception of number, properly so called, is formed at all; that is, the idea of the number of things in a group is not distinctly abstracted from the objects themselves. In the second stage the fingers and toes are used, and counting can be carried as far as ten or twenty, or perhaps, by the use of more than one man, even a little further; but corresponding numeral words are not yet invented, so that counting is by gestures. In the third stage, words or expressions describing the gestures used in the second stage are assigned to do duty as numerals, and in the course of time they become pure numeral words—that is, they are used merely to indicate numbers, the mind no longer thinking of them as describing gestures that once served the same purpose.

The question now arises whether we can find any trace of finger-counting in our own numerals, and whether we can trace the origin of the lower numerals—those in which we should not naturally expect to find a finger origin. Mr. James Gow, of Cambridge, in his Short History of Greek Mathematics, Chapter I, gives some reasons that seem to show that our own Aryan ancestors, like other races, could not at first count beyond three or four, and afterward learned to count on their fingers. His reasons are three, as follows: 1. The words for 1, 2, 3, and 4 show a different grammatical character from the next six. He says (page 2): "The first three are adjectives, agreeing with only casual and partial exceptions (e. g., δύο) in gender and case with the substantives which they qualify. The same might be said of the fourth, but that in Latin *quattuor* is wholly indeclinable. The rest, from 5 to 10, are generally uninflected, and have, or had originally, the form of a neuter singular." 2. The existence of three grammatical numbers—singular, dual, and plural—probably points to a time when more than two was regarded indefi-

nitely as many. 3. The names of the six numerals, from 5 to 10, may possibly be derived etymologically from a hand or finger source.

Mr. Gow's statements with regard to the grammatical character of the words is easily seen to be quite what we should expect. When man first begins to count, the numerals do not represent to him abstract ideas. He does not think of "2," for example, as a mere number, as we do. It represents nothing to him if separated from the group of objects which it is used to describe. The numeral words, therefore, naturally take on the form of adjectives. Later, when his ideas are further developed and he begins to use his fingers in counting, the real idea of number begins to assert itself, and the words used to designate different numbers appear in a more abstract form. The fingers become, in fact, when used thus, real numerical symbols, as much so as written ones, and the mind gradually becomes accustomed to thinking of the number of a set of objects as something which can be considered apart from the objects themselves, and which can be represented just as well by an equal number of other objects differing from the first set in all respects except that of number. Thus the *abstract* idea of number is formed.

Mr. Gow's ideas upon grammatical number seem to me, if they have the significance he claims, to point back still further. As soon as the idea of two or more as distinct from one is conceived, the necessity for a new grammatical form arises. Now, if the number sense were at all developed, the formation of grammatical number ought to stop here; for it would be apparent at once that to have a different grammatical form for every number is impracticable. But we find a distinct inflection set apart to express two, and a new inflection to designate three or more. The existence of this third or plural number would then indicate that the idea of three, or many, as distinct from two corresponds to another step in the development of the number sense. That the process of forming new grammatical numbers went no further then becomes an argument to show that the subsequent number development was more rapid, and the impossibility of making the former keep pace with the latter was realized.

The etymology of the first three or four of our numerals is probably quite beyond our reach. It has already been pointed out that in the selection of words to represent 1 or 2 the savage has such a wide range of objects to choose from that it is very much a matter of chance what he will select. Any concrete object that possesses the essential quality of unity or duality may be impressed into the service. For 3 and 4 the range of objects that will serve his purpose is more limited, but it is still sufficiently large to make it a mere accident what he will

use. For example, the Abipones of the Paraguay region express 4 by "toes of an ostrich," and 5 by "*neenhalek*," a five-colored, spotted hide. Nevertheless, some attempts have been made to discover these etymologies.

Below is given a list which includes, besides those for 3 and 4, some etymologies that have been suggested for the higher numerals. I quote from the work of Gow already referred to, page 3, footnote: "The common derivations, taken chiefly from Bopp, are set out in Morris's Historical Outlines of English Accidence, page 110, note. The following only need be cited:

"*Three* = 'what goes beyond' (root *tri*, *tar*, to go beyond).

"*Four* (quattuor) = 'and three'—i. e., 1 and 3.

"*Five* = 'that which comes after' (four), Sk. *pashchât* = after.

"*Six;* Sk. *shash*, is probably a compound of two and four.

"*Seven* = 'that which follows' (six).

"*Eight*, Sk. *Ashtân* = 1 + and + 3.

"*Nine* = *new* = that which comes after 8 and begins a new quartette.

"*Ten* = two and eight."

In commenting on these etymologies Gow says (pages 3 and 4): "When they say that *pankan* and *saptan*, 'five' and 'seven,' mean 'following,' because they follow 'four' and 'six' respectively, they suggest no reason why any other numeral above 1 should not have been called by either or both of these names; so when they say that *navan*, 'nine,' means *new* (νέος, etc.) because it begins a new quartette, they assume a primeval quaternary notation, and do not explain why 'five' was not called *navan;* so, again, when they say *navan* means 'last' (νέατος, etc.) because it is the last of the units, they evidently speak from the point of view of an arithmetician who has learned to use written symbols." The objections offered by Mr. Gow to these etymologies seem to me to be quite valid, with the exception of the last. It is not at all uncommon to find "9" expressed by some such phrase as "approaching completion," the fingers forming the natural scale, and serving the purpose of written numerals. The savage would be therefore in this respect in the position of an "arithmetician who has learned to use written symbols." In the Jiviro scale 9 is "hands next to complete" (Conant, page 61); in the Ewe scale it is "parting with the hands" (ibid., page 92), and in the Chippeway dialect the same numeral is *shangosswoy*, which is akin to *chagissi*, "used up" (ibid., page 162).

The derivations of the last six of the first ten numerals suggested by Gow are as follows: "Their original names appear to have been *pankan* or *kankan* (5), *ksvaks* or *ksvaksva* (6), *saptan* (7), *aktan* (8), *navan* (9), and *dakan* or *dvakan* (10). Some allusion to finger-counting may well underlie these words. Ever

since A. von Humboldt first pointed out the resemblance between the Sanskrit *pañk'an* and the Persian *penjeh*, 'the outspread hand,' some connection between the two has always been admitted. . . . So also *dvakan* seems to be for *dvakankan*, meaning 'twice five' or 'two hands'; *dakan* points to δεξιός, *dexter*, δέχομαι, etc., or else to δάκτυλος, *digitus*, *zehe*, *toe*. Thus, whatever original forms we assume for these two numerals their roots appear again in some name or other for the hand or fingers. It is intrinsically probable, therefore, that *pankan* means 'hand,' and that *dakan* means 'two hands' or 'right hand.' It may be suggested here that the intervening numerals are the names of the little, third, middle, and fore fingers of the right hand. Thus, the little finger was called by the Greeks ὠτίτης, by the Latins *auricularis*. This name is apparently explained by the Germans, who call this finger the 'ear-cleaner.' Now, *ksvaks* or *ksvaksva* seems to be a reduplicated form, containing the same root as ξέω, ξαίνω, ξυρέω, etc., and meaning 'scraper.' The name *saptan* seems to mean 'follower' (ἕπ-ομαι, etc.), and the third finger might very well be so called because it follows and moves with the second, in the manner familiar to all musicians. The name *aktan* seems to contain the common root AK, and to mean, therefore, 'projecting,' a good enough name for the middle finger. Lastly, the first finger is known as ἀσπαστικός, *index*, *salutatorius*, *demonstratorius* (= 'beckoner,' 'pointer'), and the meaning probably underlies *navan*, which will then be connected with the root of *novus*, νέος, *new*, etc., or that of νεύω, *nuo*, *nod*, etc., or both. Whatever be thought of these suggested etymologies, it must be admitted that there is no evidence whatever that our forefathers counted the fingers of the right hand in the order here assumed. They may have adopted the reverse order, from thumb to little finger, as many savages do,* and as, in fact, the Greeks and Romans did with that later and more complicated system of finger-counting which we find in use in the first century of our era. If this reverse order be assumed, the numerals may still be explained in accordance with other finger-names in common use, besides those which have been cited. But, after all, the main support of these etymologies is their great *a priori* probability. The theory on which they are based brings the history of Aryan counting into accord with the history of counting everywhere else; and it explains the Aryan numerals in a way which is certainly correct for nearly all other languages. It is hardly to be expected that such a theory should be strictly provable at all points."

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* The order of counting from the little finger to the thumb is, however, the more usual method with savages. See a paper by Lieutenant F. H. Cushing, entitled Manual Concepts, in the American Anthropologist for October, 1892 (vol. v).

Before leaving this part of the subject the writer wishes merely to add that the etymologies suggested above for six, seven, and eight appear to be quite plausible; for *navan*, or nine, however, it appears to him that the association with the idea of "last" is the more reasonable, and would fit in with the finger interpretation of the others just as well as the one suggested.

We return now to the general question of the development of number systems, which we left at the point where men were supposed to have learned to use their fingers and toes as a natural abacus, and to have reached, therefore, the number 20. Before any further progress can be made a scale of notation must be adopted. Of course, this is not done consciously. Within certain limits it is probably entirely a matter of chance what number will be selected as a base. I had better say what number will become the base; for the use of the word "selected" unconsciously implies that the savage exercises a choice, while in fact, as already stated, he is simply led by circumstances. In most cases he has adopted some kind of a base before he has counted as far as 20. We have already seen that one of the commonest forms for "6" is "hand-one" or five-one. When the savage expresses 6 in this way he is committed to a quinary scale. The chances are, however, overwhelmingly against his carrying out this system consistently in all higher numbers, and for very obvious reasons. A pure quinary system of numeration is therefore extremely rare. Nevertheless, at least one such exists, one that is purely quinary as far as it seems to be known; this is the scale of one of the Betoya dialects of South America. In this scale

Six = *teyente tey* = hand + 1.
Eleven = *caya ente-tey* = 2 hands + 1.
Sixteen = *toazumba-ente-tey* = 3 hands + 1.
Twenty = *caesea ente* = 4 hands.

(Conant, pages 57 and 140.) It would be interesting to know whether this scale is carried on consistently—that is, whether 25, the square of the base, is recognized as a new starting point, or whether they call it simply "five hands," without any sign to mark it off distinctly from other multiples of the base.

What is generally found in these scales that introduce the quinary element at 6 is that "10" is designated by some expression other than "two fives"; and eleven then becomes 10 + 1; twelve, 10 + 2, etc.—that is, the quinary scale here merges into the decimal; and either we see no more of it, or it continues with the other in a subsidiary place. The latter is the more usual. Thus sixteen is 10 + 5 + 1; seventeen, 10 + 5 + 2, etc. Thus is formed a mixed decimal and quinary scale.

It is a question over which there has been considerable dis-

pute whether all numeral systems were not originally quinary, and the adoption of a larger base came as, with the lapse of time, its superior advantages were recognized. I think that not only is the evidence in favor of the opposite view, but also that from *a priori* considerations we might expect to see the adoption of 10 as a base as readily as 5. It depends, I think, entirely upon whether 6 is called "five-one" or is designated in some other way. In speaking upon this point Prof. Conant says (pages 170, 171): "From the fact that the quinary is that one of the three natural scales with the smallest base, it has been conjectured that all tribes possess at some time in their history a quinary numeration, which at a later period merges into either the decimal or the vigesimal, and thus disappears, or forms with one of the latter a mixed system.* In support of this theory it is urged that extensive regions which now show nothing but decimal counting were, beyond all reasonable doubt, quinary. It is well known, for example, that the decimal system of the Malays has spread over almost the entire Polynesian region, displacing whatever native scales it encountered. The same phenomenon has been observed in Africa, where the Arab traders have disseminated their own numeral system very widely, the native tribes adopting it, or modifying their own scales in such a manner that the Arab influence is detected without difficulty.

"In view of these facts and of the extreme readiness with which a tribe would through its finger-counting fall into the use of the quinary method, it does not at first seem improbable that the quinary was *the* original system. But an extended study of the methods of counting in vogue among the uncivilized races of all parts of the world has shown that this theory is entirely untenable. The decimal scale is no less simple in its structure than the quinary, and the savage, as he extends the limits of his scale from 5 to 6, may call his new number 5-1, or, with equal probability, give it an entirely new name, independent in all respects of any that have preceded it. With the use of this new name there may be associated the conception of '5 and 1 more'; but in such multitudes of instances the words employed show no trace of any such meaning, that it is impossible for any one to draw with any degree of safety the inference that the significance was originally there, but that the changes of time had wrought changes in verbal form so great as to bury it past the power of recovery."

In support of this argument it may be said that at least in the languages of the most cultivated races to-day those elements of

* An elaborate argument in support of this theory is to be found in Hervas's celebrated work, *Arithmetica di quasi tutte le nazioni conosciute.*

their numeral systems which are not homogeneous with the main characteristics of the system show great persistence. The "score" of English is a remnant of old vigesimal counting, and although it has lost its place in the ordinary number system, it is still retained as a semi-poetical form. Still more marked is the "quatre-vingts" of the French. In counting from 61 to 99 they use a purely vigesimal system. If these traces of vigesimal counting still remain, it would seem probable that if the quinary system had ever formed a part of the system it would also somewhere have left its marks, fainter, it is true, on account of its greater antiquity, but still discernible. Now the only indication from a philological source that such a system was ever employed by the Aryan peoples seems to be the Homeric πεμπάζειν (literally to five), meaning "to count." It is sometimes stated also that the form of the Latin numerals I, II, III, IIII or IV, V, VI, etc., implies the existence of an early form of quinary counting. My own opinion is that evidence derived from written numerals, between which and the formation of the numeral system itself there can be no comparison as to dates, can be of very little weight in deciding what was the scale upon which the system was originally formed. If the Roman V for 5 and VI for 6 were adopted because of a quinary element in the Roman scale at the time these signs were first used, surely the spoken language would have retained some marks of the same system. The evidence all points, therefore, with the one exception quoted above, to the nonexistence of a quinary element in Aryan counting.

The third natural scale, besides the quinary and decimal, is the vigesimal. It is doubtful whether a pure vigesimal scale, unmixed with any quinary and decimal element, occurs in any part of the world. In certain regions, or with certain races, a strong tendency is found to make 20 the principal base of the numeral system. This is so with the Celtic peoples, with some Asiatic and a few African tribes, with some of the Eskimos, and with the peoples who formerly occupied the Central American regions. If a tribe counts up to 20, using their fingers and toes, and then continue their counting beyond this point in a consistent way, a vigesimal system will be the natural result; but on account of the practical difficulty of using the toes in any system of gesture-counting, which, as we have seen, is the second stage in the development of the number system, it seems plausible that most tribes confined themselves to the fingers alone. This would account for the greater predominance of 10 and 5 as number bases. It is true that in the case of many well-developed vigesimal scales we have no positive evidence that they originated in the custom of counting on the fingers and toes, but there is certainly great probability that they did all begin in this way. There seems

to be no other good reason why 20 should have been adopted for a base. The most perfect examples of vigesimal scales are those of the Mayas of Yucatan and of the Aztecs of Mexico. It has already been mentioned that traces of this system are to be found in our own English numerals and in those of the French. Danish and some of the kindred languages show a strong tendency to vigesimal forms, although, as a whole, the Germanic systems of counting are purely decimal.

Among the important number systems of the world there is one which uses neither 5, 10, nor 20 as its base — namely, the sexagesimal scale of the ancient Babylonians. This system is of special interest to ourselves, for its influence is still felt in the division of our degree into 60 minutes, and the minute into 60 seconds. It seems to have arisen and continued in use side by side with a decimal system, for the monuments furnish examples of numbers which are wholly decimal, others wholly sexagesimal, and still others in which the two systems are combined. It is a question of great interest to know how such a system came to be adopted. It seems reasonable to suppose that it was formed artificially—that is, 60 did not come to be the base of this system by a process of natural development, as 5, 10, or 20 came to be the bases in the systems of other races. In all probability, therefore, it grew up after the decimal system, and may have been invented for the purposes of astronomical calculation, for the Babylonians were famous astronomers in their day. It is not impossible to suppose that its purpose originally was to render the calculations of the astronomers less intelligible to those who were acquainted with only the decimal scale. However that may have been, its use apparently became common. M. Cantor, the German writer on the History of Mathematics, seeks to explain its origin by saying that the Babylonians divided the circle of the heavens into 360 degrees, one degree for each of the 360 days into which they divided the year. They were probably also acquainted with the fact that the chord equal to the radius subtends exactly one sixth of the circumference, or 60 degrees. This may have led to the adoption of 60 as the number base. Prof. John P. Peters, in a letter published in the Proceedings of the Society of Biblical Archæology for May, 1883, pages 120, 121, says, in substance: The use of the fingers of one hand to count to 5 was in some cases extended to 6, by using the open hand with the fingers and thumb extended to express 5, and then indicating 6 by the closed hand. This method, if extended to both hands, gives rise ordinarily to a duodecimal system; and we have abundant evidence both in our own English and in some other languages of the presence of a duodecimal element, which may have arisen in the way suggested. The Babylonians, however, instead of devel-

oping a pure duodecimal system, combined the seximal with the decimal in a multiplicative manner, and so developed a sexagesimal system.

The reader may take his choice between these two attempts to explain what, in any case, must be regarded as a remarkable phenomenon. Without denying that either may possibly be the true explanation, the writer is of the opinion that much additional evidence will be required to finally solve the question. With the rapid advance that is now being made in the field of Babylonian antiquities it is not impossible that the needed information will be forthcoming.

IVORY: ITS SOURCES AND USES.

By N. B. NELSON.

THOUGH an animal product, its combinations with wood, particularly *ebony*, from the earliest history, and the similarity of its uses and working in the way of carving, turning, veneering, and inlaying, make ivory an interesting material to joiners, decorators, and builders.

In texture, elasticity, hardness, peculiar markings or cloudings of the grain, and several other particulars, ivory is very like the harder woods, and, being of similar durability, is very suitable to "make up" in mosaics, inlaying, etc., with them, making a companion commodity.

Ivory is really dentine—that substance, not unlike bone, of which teeth principally consist. By usage it is restricted to the dentine of those teeth which are large enough for industrial purposes—viz., the tusks of the elephant, hippopotamus, walrus, narwhal, and some varieties of whales. These forms of ivory differ about as the hard woods differ: the elephant ivory, by its size and quality, is best suited for all purposes; that of the hippopotamus is harder and finer, but owing to its hollowness can only be used for small articles. The old Norsemen used extensively the tusks of the walrus, and when "whaling" was at its best the sperm whale was sought almost as much for the ivory as for the oil. It was the writer's fortune to examine a whale's tooth which was nine or ten inches in length and six or eight in circumference, and seemed solid ivory of a beautiful quality, but so hard as to defy every effort of its owner, who was an expert carver, spoiling, as he expressed it, his "tools and temper."

Ivory, consisting chemically of an organic matrix or growing element, phosphate and carbonate of lime, is permeated by numerous exceedingly fine canals, starting from the organic or pulp cavity and running generally outward to the circumference of

the tusk. To the regularity and smallness of these canals ivory owes its elasticity, firmness, and fineness of grain; to their curvatures and eccentric direction—plainly visible in cross-cut sections—are due those beautiful cloudings and delicate markings which give value to, and readily distinguish the real from the imitated article.

Ivory is extremely hard and heavy—the very name, a Latin derivative from *barrus*, an elephant, so called from a Greek word meaning heavy. It is difficult to cut, requiring the sharpest and hardest of tools, but yields readily to the saw, the lathe, the file. Owing to its value, which is so constantly increasing that it now ranks with the "precious" substances, the greatest care is taken to avoid waste in manipulation. The cutting is effected with thin saws. Large plates of veneer have been obtained by the "reciprocating" saw, cutting a spiral shaving round the tusk. There is an account of one thus produced which was forty feet in length and twelve inches wide. Polishing is done by the use of various powders.

Ivory is dead pearly white in color, which sometimes changes with age and exposure to yellow, brown, or black. This natural whiteness is exquisitely delicate, and, as an enthusiast in ivories expresses it, "bears a great resemblance to the brightest tint of the human skin, which latter is the most beautiful hue in Nature." On account of the yellowing with age, there have been many recipes for restoring its whiteness, but none have proved satisfactory. A fortune is in store for the inventor or discoverer of the "happy medium." The opacity and elasticity of old ivory can be partially restored, at least to be useful for some purposes, by boiling in a solution of gelatin.

The existence of statues and of plaques of ivory larger than could be cut from any known tusk, render it probable that ancient workers possessed some method of bending or molding. It can be made flexible by a bath of phosphoric acid, but at the expense of many of its properties. It will also take a variety of dyes without interfering with its polish, particularly if the actual matrix or organic matter is stained.

The tusks of the elephant are an elongation of the upper incisor teeth, which may attain to enormous development; the largest are those of the extinct mammoth; some specimens have been found in Siberia more than twelve feet in length and two hundred pounds weight. There was a noted one of particularly fine quality, weighing one hundred and eighty-six pounds, that was cut up into piano keys.

Among the modern elephants the African possesses the largest tusks, often nine or ten feet in length, and weighing one hundred and sixty pounds each. A pair of African tusks was exhibited

in London recently that weighed three hundred and twenty-five pounds, and measured eight and a half feet in length and twenty-two inches in circumference. Think of the muscular strength of head and neck necessary to support such a weight! The importance of these "ivories" in combat is evident by the dread of a "tusker" shown by elephants less favored. They are often broken in fighting, and always show marks of considerable wear. While even captive animals use them for a variety of purposes —e. g., a trained elephant when directed to pull a rope, will take it between his molar teeth and pass it over one of his tusks to get a good purchase. Nothing of less strength and elasticity than ivory could withstand the strain to which it is constantly exposed.

Foreign bodies, as bullets, arrowheads, or spear points, are often found imbedded in ivory. It is not a rare occurrence for the sportsman's bullet, or the native's spear, intended to pierce the elephant's brain, to penetrate the pulp cavity of the tusk and there become encysted or grown over with ivory and apparently have given the animal no trouble; but occasionally the viciousness of a "rogue," or the evident insanity of some unmanageable creature, has proved after death to have been caused by the suffering from inflammation and suppuration consequent upon the presence of a leaden ball in the "nerve of the tooth."

The best ivory is the African, and the finest quality from near the equator. Much of it is brought by natives from the interior to the coast and sold to Arab merchants, while many expeditions are organized by Europeans to go to the interior and collect the stores gathered by the native tribes. It is an extensive commerce. Four thousand pounds sterling, or twenty thousand dollars, is considered a good result for one season's expedition with one hundred and fifty men. Prices differ in different localities. The "portage," or distance from coast, size, condition, care in handling, and weight all affect price.

The African ivory trade is an ancient one, and in mediæval times Marco Polo, who lived from 1254 to 1324, speaks of the ivory traffic in Zanzibar being "astonishing in amount."

The tusks of the mammoth of northern Siberia, or the fossil supplies, are said to furnish almost the whole material of the Russian ivory workers. They are found in extraordinary abundance, and come principally from the neighborhood of the Lena and other arctic rivers and the coast islands. Mammoth tusks are more slender, more curved, and much larger in proportion than those of recent animals. Many have been found in the frozen morasses or in the solid ice, intact and in a beautiful state of preservation, having lain in their air-tight cases for many centuries.

Among the Scandinavians the tusks of the walrus have long been a source of ivory, and of very good quality too. The spirally twisted tusk of the narwhal is the desideratum of the Eskimo hunter. Asiatic ivory is from India and Ceylon elephants, which are rapidly disappearing. America has some fossil deposits and "glacial preserves" of mastodon ivories, but they are more sought for museums and antiquarian collections than for any commercial value.

The uses of ivory are exceedingly varied. The large cuttings are for veneer, plaques, panels, and portraits; then billiard balls, knife, cane, umbrella, and brush handles, piano keys, buttons, measuring rules, mathematical scales, statuettes, caskets, chessmen and draughtsmen, furniture decorations, and an endless variety of ornaments and works of art.

Ivory working is one of the oldest industries. Numerous references occur in the Old Testament which show that the material was regarded as of great value. It was an element in temple decoration, and is often mentioned among the presents to kings, who employed it for regal state. The ancient Egyptians and Assyrians used it extensively.

The excavations of Nineveh, a city that dates nearly 2000 years B. C., have supplied the British Museum with ivories of very great antiquity, many of them in good preservation, and many others tolerably well restored by boiling in gelatin; all show considerable artistic merit and mastery of the material.

Solomon had an ivory throne inlaid with gold—*vide* description in Chronicles; and the throne of Penelope, of about the same date, is said to have been of ivory and silver. Those ancient carvers attained a delicacy and artistic finish that our modern artists may well envy.

The later Greeks and Romans carried this gold-and-ivory and ebony-and-ivory work to a degree of splendor which seems incredible. From their extensive traffic with Persia and Egypt they obtained immense quantities of both Asiatic and African ivories. The Temple of Juno at Olympia contained, among many great works in ivory, the coffer of Cypselus, the bed, the discus, and the statues of Juno, the Hesperides, and Minerva.

The reputation of the great Phidias was based largely on his gold and ivory sculpture. The Minerva of the Parthenon, forty feet high, and the Olympic Jupiter, fifty-eight feet, evidently surpassed anything of the kind known to moderns. The pupils of Phidias made a number of those colossal images, in which the nude parts of the human figure were in ivory and the drapery in gold.

The Romans were equally extravagant; the gates of the Temple of Apollo, built by Augustus, were of this costly material.

Charlemagne had two ivory gates of Byzantine workmanship. The episcopal chair of St. Vitalis, a work of the sixth century, is a fine specimen. Ivory seems to have become scarce in the twelfth century, and bone was largely used for carving, but during the middle ages ivory again became plentiful, and with the renaissance the art of carving reached perfection.

Florence, Flanders, and Germany were great centers. Cellini, Michael Angelo, Raphael, Dürer, and others tried the old-new art. In the seventeenth century there were many celebrated ivorists. Monks in cloisters frequently devoted a life to carving a crucifix; there are several specimens in different museums.

Schliemann, in his excavations at the supposed site of Troy, found many articles of ivory, useful and ornamental. The French town of Dieppe has had celebrated ivory factories since the fifteenth century, and is still extensively in the trade; but it is in the East, and especially in China, that ivory is most highly prized and worked into decorative forms.

No amount of care and patience is considered excessive among the Chinese in this work of ivory-cutting. This is evident in the extremely minute and delicate workmanship of their carved, lacelike trays, while their nests of concentric ivory balls are well known and are reckoned among the puzzles of industry.

The earliest recorded history—we might say prehistoric, the hieroglyphical—that has come down to us has been in carvings on ivory and bone. Long before metallurgy was known among the prehistoric races, carvings on reindeer horn and mammoth tusk, evidence the antiquity of the art. Fragments of horn and ivory, engraved with excellent pictures of animals, have been found in caves and beds of rivers and lakes. There are specimens in the British Museum, also in the Louvre, of the Egyptian skill in ivory carving, attributed to the age of Moses. In the latter collection are chairs or seats of the sixteenth century B. C. inlaid with ivory, and other pieces of the eleventh century B. C. We have already referred to the Nineveh ivories. Carving of the "precious substance" was extensively carried on at Constantinople during the middle ages. Combs, caskets, horns, boxes, etc., of carved ivory and bone, often set in precious stones, of the old Roman and Anglo-Saxon periods, are frequently found in tombs. Crucifixes and images of the Virgin and saints made in that age are often graceful and beautiful. The Chinese and Japanese are rival artists now in their peculiar minutiæ and detail.

Nothing is wasted in manipulating ivory; all dust, shavings, chips, and small pieces are utilized by being converted into gelatin, or ivory black, or artists' pigments; confectioners and *chefs* make use of ivory dust. Owing to the constantly increasing price, many attempts have been made to imitate ivory, but with poor

success. Billiard balls and other small articles have been made of celluloid, a combination of gun cotton, camphor, and ivory dust, but none have been satisfactory to the workman, whether carver, turner, or miniature painter.

There are not less than fourteen extinct but only two or three living species of elephants. Like the American buffalo, they are becoming less numerous every year. Though long-lived—some have in captivity lived over one hundred and fifty years—they propagate very slowly, the most slowly of any known animal; the period of gestation is twenty-two months, and but one at a birth, and they are gradually disappearing before the hunter. One writer states that England's imports of African ivory alone average in one year 15,550 hundredweight, worth from £600,000 to £750,000, or between three and four million dollars, and predicts the certain decrease of supply and consequent increase of value of ivory.

THE PARADOX OF DIDEROT.

By M. ALFRED BINET.

HAVING had occasion several years ago to converse on subjects of psychology with a number of comedians, I sought their opinion concerning the "paradox of Diderot," and, finding much in their answers that was instructive, I took them down. I afterward completed the inquiry by questioning several of the actors connected with the Théâtre Français. The subject had been already studied by W. Archer (cited by William James in his Psychology), but I was at the time ignorant of his work. So far as I can judge, I reached the same conclusions as he.

Diderot's Paradox of the Comedian is not a very profound work, but deals in scattered facts of little intrinsic weight, and his arguments are not very forcible.

His thesis is that a great actor must not be sensitive; or, in other words, that he must not feel the emotions he expresses. "Extreme sensitiveness makes poor actors; while absolute lack of sensitiveness is a quality of the highest acting." He sustains this view by six arguments, viz.: we can not repeat emotion at will, but the power is soon exhausted; the age when the comedian is at his greatest is not youth, when he is quick and full of emotion, but after he has had a long experience, when the ardor of his passions has subsided and his head is calm and his spirit self-possessed; certain facts going to show that the performer's real feelings are different from those which he is expressing on the stage; and, finally, his best argument, and the one on which his thesis mainly rests, that one can not do two things at a time.

The actor has to be observant of his playing, to regulate its effects, his gestures, and his exclamations, to see that they are correct, to keep his mind on the scene, to recollect his part. All this critical work is incompatible with sincere emotion. When a person is really moved, when he feels some great woe, while he may indeed sink upon a chair as the actor does in the scene, he does not keep watch of his attitude while falling or think how to make it expressive and harmonious, but gives himself wholly up to his trouble.

The nine comedians whom I interrogated were unanimous in declaring that Diderot's thesis can not be sustained, and that the actor on the stage always feels, in some degree at least, the emotions of his character. I have been told that other comedians are of a contrary opinion—the elder Coquelin professes not to feel anything of the kind; but I have not conversed with M. Coquelin, and can not verify this assertion. Madame Bartet, of the Comédie Française, says, in writing: "Certainly I feel the emotions of the characters I represent, but by sympathy, not on my own account. I am not, indeed, moved before my audience is, but my emotion is of the same kind as theirs, and is only preceded by it. The extent of the emotion varies on different days, and very much according to my moral and physical condition; and to feel nothing, as happens sometimes, but rarely, is very depressing."

Replies from other actors are to a like effect. M. Worms, of the Comédie Française, says that at certain periods when he is playing scenes of passion or tenderness, the eyes of his comrade are moistened, and that those who do not enter into sympathy with their parts are generally themselves without feeling. M. Mounet Sully and his brother Paul Mounet hold that the art of the comedian consists in this very capability of realizing the emotions of his part with the intensity of actual life; and that on those days when he is without emotions he fails to attain the desired power. The power of realization diminishes, however, if the piece is repeated too many times in too rapid succession, as in M. Paul Mounet's case after the fiftieth representation.

It must be admitted that some actors, as, for instance, Sarah Bernhardt, may become such virtuosos in their parts as to become complete masters of their organisms, and produce the emotions at will.

The emotion of a part does not constitute all of it. A character lives in a piece, mingles in its action, and has his interests, ideas, and characteristics—a personality, in short, the development of which depends on the talent of the author. The actor who plays a part, especially one who creates it, should undergo a metamorphosis, and forget his own personality for a few hours, to put on a borrowed personality. Madame Bartet enters so thoroughly

into her part that she puts on features not described by the author, but conformable to its character, thus going far toward completing the personality—filling in the outlines—which the author has sketched. M. Paul Mounet says that one can not master a character till he has mastered its reflex actions, its unconscious movements, gait, etc. M. Got tells us that the comedian's great pleasure is the pleasure of metamorphosis, of becoming for the moment in various things the personage he represents. M. Truffier believes that his profession would be in a crude state without the gift of such metamorphoses. He adds that he experiences these metamorphoses more completely in old plays, which take him out of the range of present life, than in those of to-day.

An important fact to be noted is that each actor plays a part according to the sensibility peculiar to him. M. Mounet Sully speaks of a combination of the character of the personage evoked and that of the actor, and observes that no two actors play the same part in the same way. Madame Bartet says that she is not capable of rendering every kind of emotions, and that she represents some categories better than others. Actors usually play parts having a certain degree of agreement with one another, and are liable to fail when they undertake a part of a different type. This restriction of ability is in part of physical origin, but is also largely moral or emotional.

The power of sustaining emotion and the duration of it vary among actors much, as M. Le Bargy has observed, as some horses excel in speed and others in bottom.

As to the exact nature of artistic emotion, Madame Bartet regards it as real in the sense that it produces the same physical effects in the organism as one would feel on his own account. She is oppressed in a scene of continued grief, is transported in another scene, and becomes wearied with the condition, especially when the emotions correspond with those natural to her.

Artistic emotion has, however, the two peculiar characteristics of being always agreeable and of being subject to the will. The answers we have reviewed are very precise. Othere are less definite; and some of the comedians to whom we have applied have simply answered that the factitious emotions inspired by the parts are less intense than real ones; but M. Mounet Sully is of the opinion that the emotion is lived and felt as if it were real.

We come now to Diderot's principal argument, that one can not be moved by emotion and be critical at the same time. Without availing ourselves of the fruits of recent researches on complex consciousness, we will merely refer here to what we have learned concerning the case in hand. M. Got found no difficulty in supposing the combination of the two functions, in dramatic repre-

sentation or in oratory. M. Le Bargy regards the emotions of the theater as very much like those of real life. When we are sincerely moved on our own account, we nevertheless remain critic and judge; and only in exceptional circumstances, when the passions are very strong and absorbing, do we lose the critical sense. Madame Bartet finds the thesis of Diderot so far correct that an excess of emotion may restrain the actor and paralyze his resources. He must not be dominated by his emotion, but must control it. But to be in emotion while one controls it implies no contradiction; one can duplicate himself in the theater the same as in life. In the highest anger one has within himself something that says, "I am in too great passion, I am going too far, I must not say that." Yet sometimes, notwithstanding that inner voice, we do not stop in time. The same, in substance, exists in the theater. We watch, we judge—we duplicate ourselves.

Regarding the exact nature of this duplication, Madame Bartet says that during the period of preparation she feels the personality of her part taking possession of her till it substitutes itself for her own as to all the interests of common life; in the scene the doubling is very clear, but under control: "I am all the time seeing and hearing myself; I attend my play. I duplicate myself enough to hear the sound and intonations of my words, the succession of my attitudes, movements, and gestures, but not so far that I cease to appropriate them to myself. The duplication is intensified when, instead of playing, I read." The forgetting of personality varies with the nature of the parts and with numerous other circumstances. M. Truffier relates that once he was obliged to play two characters in farce in the evening after the sudden death of his infant son. He played the first piece automatically, but gradually warmed up to the situation, until his second character took possession of him, putting aside the father's grief. It did not extinguish it, but remanded it to a secondary position. Many like observations are known in science, but this is of special interest, because I got it at first hand. Exceptional circumstances are evidently required for the actor to forget his personality wholly. It is an ideal which some pursue but not one in a hundred reaches. We may remark that when the actor incarnates the personage within himself, he ceases to duplicate himself, but becomes another—the personage. The doubling occurs only when the incarnation is incomplete. Furthermore, the relations between the rival personalities are not fixed once for all, but probably vary from day to day, and with the parts. Then the characters of the actors, their moods, and their relations with the audience have much to do with the matter. Madame Bartet says that she communicates directly with the audience, and feels very distinctly whether it is in sympathy with her or opposed to

her. "If I feel that I have not gained it over far enough, I make an intense physical effort to accomplish this. At the climax of emotion, the public appears quite indistinct, like a collective mass; but when my part only half possesses me, I discern the slightest movements occurring in the hall. I have a very clear perception of the silence that denotes that the attention of the audience is fixed, as I have also of its wandering."

We come now to the illusion of the theater as it is felt by the spectators. Taine's description of it as something that is alternately excited and destroyed is not sustained by the persons whom I have interrogated, and so little resembles the reality that I suppose it is a purely theoretical and systematic explanation, invented in all its parts, perhaps unconsciously, by one who was nothing less than he was an observer. As I interpret the teaching of observation, we most clearly and curiously perceive the illusion side of the spectacle when we enter the theater after the curtain has been raised, and are still in the lobbies regarding from a distance what is passing on the stage. At that moment we have a very strange impression that the actors are playing false, and all that there is of the conventional in the theater stands out before us. This impression is strongest at the beginning, and is gradually dissipated as we listen and comprehend the piece. Leaving aside this somewhat exceptional circumstance, and describing what the spectator usually experiences at the theater, we may theoretically, after the manner of Taine, distinguish two different states of consciousness in our minds: we are moved by the piece, and are aware that it is a fiction. But these two states of consciousness in the large majority of cases have not each an independent life, and do not take each other's places by turns. Our real experience is a complex, composite feeling, in consequence of which we are captured by the emotions of the piece while still vaguely aware that it is a fiction. There are not two contrary acts of the mind, two antagonistic attitudes, but everything is mingled and fused. There are at the same time, in our minds, an emotion of the spectator, a feeling of the illusion, a critical judgment on the actor's playing and the merit of the piece, and a good many other things.

About ten years ago, when hypnotic experiments in psychology were in great favor, the thought sometimes occurred of transforming the personalities of subjects and giving them parts to play. M. Charles Richet took the initiative in these ingenious transformations. A woman, a mother of a family, was by his suggestion metamorphosed into a general, an archbishop, a ballet dancer, or a sailor, and we are assured that she acquitted herself in her parts with a perfection which the most accomplished actor could not attain. The superiority of these subjects of suggestion,

so ignorant in most things, came, it was said, from their sincerity; they believed in the part they were playing, while the actor knows he is an actor. Our inquiry among the world of comedians has not confirmed these theoretical views. In the first place, we are not convinced that an actor of genius would be so inferior to a poor hysteric on whom the same part had been imposed by suggestion; and then this question of sincerity seems to us now susceptible of a very large number of gradations. We can not affirm that an actor plays without believing; it is true that when he has returned to his dressing room and has put away his burden and become himself again, he no longer believes in the personality of his character, although he may still retain a part of it; but in the scene, in the heat of the action, he may be moved on account of this artificial personage. The artistic emotion of the actor exists, it is not an invention; it is lacking in some, while in others it rises to paroxysm. Now, is not emotion an essential element of sincerity? In short, we believe there is no radical difference, only a shade, between the actor and the subject of suggestion.—*Translated and condensed for the Popular Science Monthly from L'Année Psychologique, vol. iii* (*G. E. Stechert, New York*).

SKETCH OF JAMES CROLL.

IN awarding the Wollaston medal of the Geological Society of England to Mr. James Croll in 1872, President Prestwich spoke of the additional value Mr. Croll's labors had in the estimation of the society from the difficulties under which they had been pursued, and the limited time and opportunities he had had at his command. Prof. A. C. Ramsay, accepting the medal for Mr. Croll, said that he was all the more deserving of the honor from the circumstance that he had risen to the place he had among men of science without any of the recognized advantages of scientific training, having won his position by his own unassisted exertions. Mr. Croll indeed pursued the work which he carried to an achievement that marked an era in geology under disabilities and in the face of difficulties that would have deterred and disqualified any but a man of the highest ability and most vigorous energy.

JAMES CROLL was born, the second of a family of four sons, at Little Whitefield, parish of Cargill, Scotland, January 2, 1821, and died in Perth, December 15, 1890. His father was a stone mason, "mild, thoughtful, and meditative, and possessed of strong religious and moral sentiments"; his mother was firm, shrewd, and observing, and gifted with a considerable amount of "com-

mon sense." Being afflicted from early childhood with a pain in his head, he was not sent early to school, but was taught at home. He afterward went to the parish school for a short time, but showed little promise of scholarship, and never could acquire an accurate style of reading or become even a moderately good speller. He was withdrawn from school because of family exigencies just at the time he was beginning to have a longing desire for a better education. This had been awakened by the sight in a shop window of the first number of the Penny Magazine, which he bought; and he continued to buy the successive numbers, and read them with zest. Shortly afterward he read Thomas Dick's Christian Philosopher, and was struck with the novelty of the ideas. He then procured other books on physical science, among which was Joyce's Scientific Dialogues. "At first," he says, "I became bewildered, but soon the beauty and simplicity of the conceptions filled me with delight and astonishment, and I began then in earnest to study the matter. . . . Even at the very commencement of my studies it was not the facts and details of the physical sciences which riveted my attention, but the laws and principles which they were intended to illustrate. This necessarily determined me to study the sciences in something like systematic form; for, in order to understand a given law, I was generally obliged to make myself acquainted with the preceding law or conditions on which it depended. I remember well that, before I could make headway in physical astronomy, . . . I had to go back and study the laws of motion and the fundamental principles of mechanics. In like manner I studied pneumatics, hydrostatics, light, heat, electricity, and magnetism. I obtained assistance from no one. In fact, there were none of my acquaintances who knew anything whatever about these subjects." But he had no taste for chemistry or especially for geology, and a suggestion made at that time that he would one day be a professional geologist would have been repelled as incredible. Seeking for an occupation to give him a livelihood, he served an apprenticeship to a millwright and worked for a time as a journeyman, repairing thrashing machines on the estates where they were situated. The conditions of this life were not pleasant, and he applied himself to house joinering, in which he had acquired considerable skill, at Kinrossie, Glasgow, and Paisley. He had when a boy received a hurt on his left elbow, from the effects of which he had never recovered. The wound now began to assume a serious character, and he was obliged to give up the joiner business and find some easier pursuit.

Not having the education, qualification, or taste to be a clerk, he concluded that some sort of occupation in the tea trade might suit him. He went to Perth to see what could be done, and, ap-

proaching the city, saw a man distributing handbills. He resolved that if these bills should turn out to relate to tea, he would follow whatever guidance they might afford him. They were the advertisements of a coffee and tea warehouse which had recently been opened in the High Street. He went there, made an arrangement with the proprietor, Mr. Irons, father of his biographer, and in the spring of 1847 opened a shop in Elgin. The situation was congenial to him, and the business gave him opportunity to read. He read Edwards on the Will; was convinced by its reasoning; and in course of time failing to find in any of the writers of contrary opinions to Edwards what he considered effective answers to his arguments, from a sturdy Arminian and sympathizer with the Rev. James Morison, founder of the Evangelical Union of Scotland (now united with the Congregational Union), he became a fixed Calvinist. The tea business had begun to be a paying one, but the condition of Mr. Croll's arm becoming such that he was unable to attend to the shop properly, he was obliged, in order to avoid future loss, to give it up and retire to Perth.

He supported himself for a little while making induction apparatus for the curative application of electricity and galvanism; then, on the persuasion of a friend who had premises to let, engaged in keeping a temperance hotel at Blair-Gowrie. The house was not furnished, and, having no means to buy furniture, he made it while the building was being finished. The hotel business proved unsuccessful, and Croll's next effort was as a canvassing agent for insurance companies, in which occupation he spent four years and a half—about the most disagreeable part, he says, of his life.

About this time Mr. Croll published his first books, which indicated a leaning of his mind toward theological speculation. They were a pamphlet on Predestination, signed "A Moderate Calvinist," and pronounced by the Rev. Dr. Morison "an extraordinary production"; a pamphlet on the Bearing of Geology and Astronomy upon the Creation of the World; and a larger work on The Philosophy of Theism, a thoughtful book, displaying considerable philosophical insight and accumen, which was eagerly discussed by a knot of students who used to meet with the author. The direct object of this work was defined in the preface to be not to prove the existence of God, but to investigate the method to be pursued in order to arrive at a proof of his existence; or, as the author described it to Dr. Morison, the solution of the problem, Given an organic body, to show how it can be rationally proved that its cause must have been a personality endowed with intelligence, will, and sensitivity. The author maintained that a purely *a priori* or a purely *a posteriori* proof of the existence of God is impossible, and that the only way is by a

method which combines both elements from experience and *a priori* elements. The Rev. Dr. John Cairns regarded the work as a positive contribution to theistic argument, and said that the author (whose name was not declared) need only to give himself entirely to this topic or any other to secure distinguished success. Five hundred copies of the book were printed, and it paid expenses and returned a small profit.

Notwithstanding it was anonymous, Mr. Croll gained a reputation from this work, which led to his connection, in 1858, with the Commonwealth newspaper, a journal at Glasgow devoted to the advocacy of temperance and social and political reform; a position which, as he was a total abstainer and a strong advocate of temperance and had forsworn the use of tobacco, suited him very well.

After he had worked a year and a half with the Commonwealth, the directors of the Andersonian College advertised for a janitor. Mr. Croll applied for the position, which involved the keeping of the museum and the free run of the libraries, and, obtaining it, entered upon its duties in the fall of 1859. He found it the most congenial position he ever occupied, notwithstanding one of its duties was the disagreeable one, of which no mention is found in his autobiography, of collecting subscriptions from private gentlemen for the support of the institution. "After twenty years of an unsettled life," he says, "full of hardships and difficulties, it was a great relief to get settled down into what might be regarded as a permanent home." But "Why so many changes, trials, and difficulties?" The disability of his arm precluded him from active work and compelled him to make changes of occupation which were not advantageous. But the main cause of his troubles, he confesses, "was that strong and almost irresistible propensity toward study which prevented me devoting my whole energy to business. Study always came first, business second; and the result was that in this age of competition I was left behind in the race." His situation in the college was compatible with study.

Mr. Croll's tastes were nearly evenly balanced between philosophical and theological speculation and the study of physical science, partly to his advantage and partly to his disadvantage; so that, as he observes, when he was engaged in physics he was continually tempted to turn aside into philosophy, and when in philosophy the attractions of physics frequently drew him over, and it was only by strong effort that he could keep in one region of inquiry without passing over into the other. Hitherto he had been engaged for about fifteen years in philosophical and theological studies, the culmination of which was his book on theism. Now the Andersonian Library afforded facilities for

physical study that he could not resist, and he began again, where he had left off in former years, with the principle of the transformation and conservation of energy and the dynamical theory of heat. The question of the cause of the Glacial epoch was much discussed among geologists. Without knowing what Herschel and Lyell had written upon the matter, he conceived the change in the eccentricity of the earth's orbit as probably the real cause, and began in 1864 a series of papers of great importance on the subject, setting forth the solutions "which make his name one of the most illustrious in the history" of theoretic geology. They were published in the Philosophical Magazine and the Reader, and were elaborated in the course of ten years in the book Climate and Time. These papers are characterized by Mr. James Campbell Irons, Croll's biographer, as "distinguished by remarkable concentration of thought, joined to a very great lucidity of exposition," and are considered by him in detail in six groups, of which those on Geological Climate and Chronology, Glacial Epoch and Glaciers, and Ocean Currents include the most weighty contributions.

The papers as they appeared attracted the attention of men of science at home and abroad. The Geological Society of Glasgow in 1867 elected their author an honorary associate, and Prof. Alexander Ramsay, chief of the Geological Survey, and Dr. Archibald Geikie, director of the Scottish department of the survey, were so struck by them that Mr. Croll was offered a position in the Scottish service, to be resident surveyor and clerk in the office at Edinburgh. He was well satisfied with his position in the Andersonian College and reluctant to leave it, but besides a larger salary this place offered some other advantages over that, and its duties promised to leave him as much time and strength to accomplish the work of investigation on which he was engaged as the one at Glasgow. He was obliged to submit to a civil-service examination. His knowledge having been acquired in a life of work and not in the formal routine of school, and he being very nervous, he failed on questions of arithmetic, and in English composition. Dr. Geikie nevertheless insisted on having him, knowing his value, and was supported by other eminent geologists; and at last the Lords of the Civil List, in consideration of many special recommendations in his favor and much labor on the part of his friends, were induced, as Lord Kelvin has it, to accept Croll's "great calculations regarding the eccentricity of the earth's orbit and the precession of the equinoxes during the last ten million years as sufficient evidence of his arithmetical capacity, and his book on The Philosophy of Theism and numerous papers published in the scientific journals as proof of his ability to write good English," and he received the appointment. The duties of

this office consisted simply in overseeing the various details of the work, and were not physically or mentally laborious; the hours were short and the labor did not produce mental exhaustion. Yet it did not leave him in quite as fresh condition as his work at Glasgow, and he was obliged to be very precise in the regulation of his life. He had early conceived a distaste for geology as involving too much the consideration of details and not giving due prominence to principles, but he had a special interest in the branch which bore upon the object of the particular study in which he was engaged—of surface geology or drift in its bearings on glacial and interglacial periods. He had begun his studies in this department before leaving the Andersonian College, and had made frequent excursions into the country in search of glacial phenomena. These excursions were continued with equal success after he went to Edinburgh; and Mr. James Bennie, who accompanied him on some of them, has left delightful accounts of them and of Mr. Croll, which are published in connection with Mr. Croll's correspondence.

In 1865 Mr. Croll suffered an affection which interfered seriously and permanently with his capacity for mental work. While bent down, assisting in putting a few tacks into a carpet, he felt a kind of twitch in his head. It did not affect his general health or impair his mental energy, but it was followed by a dull pain, which increased if he persisted in doing mental work for any length of time till it became unbearable; and he was never able afterward to keep his thoughts concentrated upon a single point as he had been before. Had it not been for this mishap, he says, all the private work which he was able to do during the twenty years that followed "might have easily been done, and would have been, in the course of two or three years." For a few years prior to the publication of Climate and Time it was with the greatest difficulty that he could manage to put together in one day as many sentences as would fill a half page of foolscap, and the appearance of the book was delayed on that account.

In the published correspondence of Mr. Croll appears a letter to him from Charles Darwin under date of July 19, 1871, stating that "Mr. Youmans [Prof. E. L. Youmans], of the United States, is very anxious to get a series of small monographs written by the most competent English authors on various subjects, to be published in the United States, and I suppose in England. Mr. Youmans is in some way connected with the great firm of Appletons in New York. He has asked me to name some of the most competent men, and I have thought that you would excuse my giving your name and this note as a kind of introduction. I should add that I do not know on what subject he wishes you to write. I do, however, know that some very good judges think

highly of his scheme." This note seems to have been given to Prof. Youmans to present to Mr. Croll. Mr. Croll wrote to Mr. Darwin in reply to it that "the gentleman wished me to write a small treatise on Geological Time; but I explained to him that, in the present state of the question, nothing satisfactory could be written on it which would be of any service to general readers. I believe he felt satisfied that the better plan was to let this subject lie over for some time to come." In February, 1872, on motion of Prof. Ramsay, the Geological Society of England awarded the balance of the proceeds of the Wollaston Donation Fund to Mr. Croll "for his many valuable researches on the glacial phenomena of Scotland and to aid in prosecuting the same." In communicating the award to Prof. Ramsay, Prof. Prestwich, President of the society, added, "Mr. Croll is also well known to all of us by his investigation of oceanic currents and their bearings on geological questions, and of many questions of great theoretical interest connected with some of the large problems in geology."

The book embodying the results of Mr. Croll's glacial studies of twenty years—Climate and Time in their Geological Relations; a Theory of Secular Changes of the Earth's Climate—was published early in 1875. It was accepted at once by scientific men everywhere as a work of great importance and of equal merit and interest; and it has not fallen from the position it took then and has held since. Men might controvert some of the author's arguments or dispute his conclusions, but no one was found to deny that it was an honest and able book and a real contribution to knowledge. Honors came to him after its publication from various directions; in the form of personal acknowledgments from the most distinguished men of science in their letters to him, and in the recognition of learned institutions and societies. The University of St. Andrews gave him the degree of LL. D.; the Royal Society of London elected him a fellow; the New York Academy of Science made him an honorary member; and he was chosen an honorary member of the Bristol Natural Society, of the Psychological Society of Great Britain, of the Glasgow Geological Society, of the Literary and Antiquarian Society of Perth, and of the Perthshire Society of Natural Science. He received also the award of the Murchison Fund in 1876 and of the Badow-Jamieson Fund in 1884. His reply to the proffer of the St. Andrews degree reveals the character of the man. He said, "I hope you will not deem it affectation when I say that I do not consider that I have done anything deserving of such an honor, and that I must look upon it more as a reward to a self-taught man for a long and persevering struggle against difficulties than for any possible results which he has as yet been able to achieve."

Having completed Climate and Time, Dr. Croll desired to abandon the study of climatology and physics in order to engage in the investigation of the philosophy of evolution preparatory to a work on that subject which he contemplated. But his book had become a topic of general discussion in which he was obliged to participate, to the extent at least of seeing that his views were correctly quoted and understood; and consequently he still published articles and wrote much in correspondence on subjects treated in it. During the summer of 1880 he suffered a strain in the region of the heart which almost completely disabled him. Making an external application of aconite, under his physician's advice, to the seat of the pain, he lost the power of speech temporarily, and contracted an impediment in utterance which did not disappear for several years. He finally thought it his duty to resign his position on the Geological Survey, and accordingly retired from the Government service in the spring of 1881. Application was made by his friends for a liberal pension, corresponding with the merits of his work, under the superannuation act; but although the Government dealt at the time with considerable liberality with other persons whose deserts were no greater than his, an allowance of £100 from the Queen's bounty and a superannuation allowance of £75 16*s.* 8*d.* a year were all that were granted him; and although repeated applications were made on various aspects of the case, and backed by what would appear to be among the most influential names in the kingdom, no more could be got.

Among the first fruits of Dr. Croll's new studies was the article on Evolution by Force Impossible; a New Argument against Materialism, which was published in the British Quarterly Review for January, 1883. It was a discussion of the question of "What determines molecular motion and force?" and an attempt to prove that force alone, motion alone, or any sort of act alone, that is, undetermined to any particular direction, is unable to account for evolution. If his conclusion were correct, it would follow that Mr. Spencer's theory of evolution by force was absolutely impossible. A copy of this article was sent, with a friendly letter, to Mr. Herbert Spencer, who answered, in substance, that he had not undertaken to deal with the ultimate cause, which he had alleged to be unknowable.

All the papers Mr. Croll had written on climatic subjects since the publication of Climate and Time in 1875 were collected, revised down to date, and republished at the end of 1885 under the title of Discussions on Climate and Cosmology. "This completed his work on geology and physics, and he quietly but deliberately closed his reading and writing on those subjects, which had engrossed his attention for a period of twenty-five years, in which he

had earned a world-wide reputation, . . . to turn to his favorite theme of metaphysics; and now he resumed the subject of which he had never lost sight since his earliest manhood."

While engaged in his book on Stellar Evolution, and particularly while preparing an article on the Nebular Hypothesis, Dr. Croll wrote to Prof. Alexander Winchell, of Ann Arbor, for a copy of his book on World Life, which he desired to see before publishing. The new book, Stellar Evolution and its Relation to Geological Time, was published in the spring of 1889. It deals mainly with the prenebular condition of matter.

Dr. Croll was now able to dictate—not to write and hardly to read—only half an hour a day. But he had one thing to do before his life work could be completed—and he accomplished it. This was the publication of his Philosophical Basis of Evolution, a book in which he undertook to state the principle of determinism, which he declared to be the foundation stone of evolution; to examine its relation to Spencerianism and Darwinism, and to prove that "force, matter, and motion can never be determined by force, matter, and motion," reaching the conclusion that "the universe, in all its beauty, joy, and fullness of life, can never be explained in terms of matter, motion, and force; so that the whole process of evolution, natural selection included, evidently points to theism." Although it was largely of a metaphysical character, the author claimed that his main conclusions were, without exception, "deduced from facts or from fundamental principles." Dr. Croll substantially exhausted himself in finishing the manuscript of this book, and the proof sheets were revised with the help of the Rev. Dr. Caird. The publisher hurried the printing of the work, in order that the author might see a copy of it before he died. A bound copy of it was put into his hand, and he examined it with evident pleasure, observing: "My work is now done. I leave the world without a regret save one"—concern for the future support of Mrs. Croll. A few days after he had read to him the favorable review of the London Times. Two days before he died, though very weak and exhausted, he was mentally "as clear and alert as in his best days," and eager to discuss with a friend some of Mr. Herbert Spencer's views.

Dr. Croll was a man of a deeply religious nature, of the strictest orthodox belief, and of a religion the earnestness and intensity of which impressed his neighbors. His correspondence abounds in expressions marking this as one of the most essential elements of his character. His piety seems to have deepened as he grew older, and was never clearer or more emphatic than in his closing days.

Correspondence.

AGE AND SUICIDE.

Editor Popular Science Monthly:

SIR: In Mr. Robert N. Reeves's interesting paper, Suicide and the Environment, Popular Science Monthly for June, 1897, there are several erroneous conclusions, which are, in my opinion, the direct result of false or incomplete statistics. Not long ago (in 1894) I had occasion to gather data from every civilized country in the world while preparing an article on suicide for the New York Medical Record; and, since Mr. Reeves expressly states that his conclusions are based on statistics (he does not introduce them, however, in his paper), I am forced to conclude that his data are false, for it is not probable—nay, it is impossible—that the gentlemen (the majority of them officials and in charge of mortuary statistics), both in the United States and abroad, from whom I, personally and through correspondence, derived my information in regard to the statistics of suicide, could have unanimously erred.

It is not my purpose to discuss all of the propositions in which I differ from Mr. Reeves; I will content myself with one. And you will please pardon me if, instead of introducing my tables in this letter, I refer you to them as they are to be found published in the New York Medical Record of August 17, 1895.

Mr. Reeves says, "The theory that we hold more strongly to life as we approach its natural conclusion is contradicted by statistics, which show that the last half of life exhibits a great increase in the rate of suicide." The conclusion here advanced is, according to my observations, wholly incorrect. According to Morselli, Quetelet, Mayr, and Wagner, the tendency to suicide is greatest at maturity, and *decreases*, after maturity, with increasing age. Of course, there is a great disparity between the number of the middle-aged and that of the aged; yet, when the proportion is properly arranged and the correct average found, it will be observed that the above conclusion holds good throughout the civilized world. In a list of a thousand suicides (I have forty-seven similar lists, gathered from all parts of the world, in which the groups of suicides range in number from two hundred to five thousand, and the periods of time embraced from five to twenty years) occurring in one locality during a period of nearly ten years, the greatest number is between the ages of thirty and forty years; after forty there is a marked decrease. I think that Morselli's average of greatest frequency for the entire world would be slightly above mine (forty-two years), probably forty-five years. This is about what I make it from his tables. According to my tables, there is an increase in the tendency to suicide from fourteen years up to and slightly beyond forty years, and then a corresponding decrease in this tendency as individuals grow older. JAMES WEIR, JR.

OWENSBORO, KY., *June* 5, 1897.

EARLY PRODUCTION OF ALCOHOL.

Editor Popular Science Monthly:

SIR: Prof. Charles E. Pellew's articles on The History of Alcohol in your issues of June and July are very interesting and attract by the amusing illustrations.

Allow me to point out that the figures of alembics ascribed to an edition of the writings of Geber, the Arabian physician of the eighth century, are from the spurious works of this author. Berthelot has shown that the treatises ascribed to Geber, which were published in Latin, French, and German in the sixteenth century, are fraudulent, and that the genuine writings of the Arabian contain far less chemical knowledge than is usually attributed to him. Prof. Pellew is right in stating that the distillation of wine is first mentioned by Albucasis, a Spanish physician, who died in 1107. He might have added that the first definite recipe for preparing alcohol occurs in the Book of Fires, by Marcus Græcus, written in the thirteenth century; in this the volatile liquid is called *aqua ardens*. Very truly yours,

H. CARRINGTON BOLTON.

UNIVERSITY CLUB, NEW YORK,
July 4, 1897.

A CORRECTION.

Editor Popular Science Monthly:

SIR: I wish to call your attention to a paragraph under the head of a Biographical Sketch of William Williams Mather, published in your journal of August, 1896, on page 553, in which a citation is made from an article by Charles Whittlesey upon the personality of the first geologic survey of Ohio. This article I have never seen, but the statement in regard to my association with Prof. Mather is not warranted by the facts.

In the spring of 1838 I went to Chillicothe, and entered in the land office seventeen thousand five hundred acres of coal and iron lands in Jackson and Lawrence Counties. These lands were purchased for some

gentlemen in Albany, Jersey City, and Philadelphia, and in which Prof. Mather, Mr. Briggs, and myself shared. These lands were known to be underlaid by coal and to be within the limit of the productive iron belt of that part of the country, being subsequently the great resource in the establishment of the city of Ironton. Subsequently, and after the suspension of the Ohio survey, Prof. Mather did purchase a tract of land upon which he established a furnace. In this venture Prof. Mitchell, the astronomer, of Cincinnati, was associated with Prof. Mather. I never had any interest in the project in any way, and when selling my lands to Mr. Campbell, of the association which founded Ironton, I refused to have any connection whatever with the business enterprise, preferring to part with my property for a moderate price rather than to be connected with any business operation.

Very truly yours, JAMES HALL.

Editor's Table.

"CHRISTIAN SCIENCE" AND SCIENCE.

IT seems as if every age must have its fad, and perhaps we should not disquiet ourselves too much about it. Long ago the question was asked why the heathen raged and the people imagined a vain thing. The question, especially the latter part of it, is equally pertinent to-day; and the answer we venture to suggest is, because they like it. It is very sweet to the unregenerate mind to be able, or seem to be able, to fly in the face of facts. Just as there are persons so constituted morally that they are unable to conceive of liberty except as defiance of law, and who, therefore, when they want to feel particularly free, resort to disorderly conduct of one kind or another, so there are those—in much greater number—to whom natural law seems an intellectual tyranny from which any escape is welcome. This we take to be the philosophy of so-called "Christian science," a delusion which to-day is playing havoc with the intellects of thousands of presumably sane and well-meaning persons.

The great beauty and merit of Christian science in the eyes of its devotees is that it affirms the thing that is not and denies the thing that is. It has to make grudging concessions to the law of gravitation and a few other primary conditions of existence. In a kind of a way it admits that certain injuries to the bodily frame may impair activity and even destroy life. That a man can not walk without legs or do much useful thinking without his head are propositions which it has not yet seen its way to combat; but it takes its revenge on the system of visible things by comprehensive denials in a host of matters only a little less indisputable. It scornfully refuses to recognize pain or functional irregularities of any kind. Fevers, indigestions, inflammations, and the whole tribe of maladies which challenge the physician's art have no foundation in reality, and only need to be suitably ignored in order to be put to flight. If Job of old could only have planted himself at the Christian-science point of view, he could have got rid of his boils in short order, and perhaps saved himself from the interminable and not overcheerful discourses of his friends. The great remedy, as recommended to-day in Christian science circles, is not to think about these things at all, and in case you can not *think* hard enough, to send for a Christian-science adept to help you. The adept will then, with

cheerful and enthusiastic mendacity, inform you that you haven't any pain, that you haven't any boils, that you haven't any rheumatism or sciatica, or whatever it may be; and if you should point ruefully to the affected part, will exclaim: "Why, that isn't you; that's a mere mass of matter—soulless matter—and you are a soul, a spirit. You ought to rule your matter and not let your matter rule you." This is a point in the proceedings at which the faith of the sufferer is sometimes severely tried. Cases have been known in which, breaking into language neither wholly Christian nor rigorously scientific, the patient has demanded to know why, if that wasn't him—even grammar may be sacrificed in these emergencies—he should be enduring such abominable tortures on account of it; and up to date the satisfactory answer of Christian science to that particular question has not been formulated.

Give people a fad, however, that they thoroughly enjoy and they will make great sacrifices for it, looking pleasant under circumstances which would test the good humor even of a Mark Tapley. Here is where the Christian scientists may sometimes score; for good spirits are certainly both a prophylactic and a remedial agency of no mean value in various physical troubles. This is the one grain of truth in their bushel of nonsense. On the other hand, they do widespread and serious moral mischief by promoting the bad habit of ignoring facts. We have heard of the case of a Christian-science practitioner who, called in to see a child whose head was covered with a herpetic eruption, declared, while looking steadily at the head, that she could not see any eruption. A little girl who by accident had cut her hand at school somewhat objected to having it bound up by the teacher, giving as her reason that her parents were "Christian science." It certainly is lamentable that, in addition to all the other influences which tend to weaken the sense for truth and fact, there should have sprung up a so-called religious society which places a willful blindness to fact at the foundation of its creed and practice. Surely that kind of thing does not need encouragement or cultivation.

Meantime, Wisdom is crying aloud. Science has revealed itself as the helper and guide of mankind, and, in reply to all questioning of its claims, points to the works it has wrought. "They are they," it may say, "which testify of me." The essential and peculiar mark of science is that it ignores no fact. "Hold thou the fact!" might be taken for its motto. It holds the fact, it wrestles with it till it yields a blessing. The individual scientific thinker, honest though he be, may ignore a fact, may turn aside from evidence that ought to command his attention; but, in so far as he does this, he is unfaithful to the mandate of Science. The fact, however, abides; and Science, through some other of her servants, or perhaps later through this very one, will take it up and make it yield its meaning. Science has all truth for its domain, and for that reason there can be but one science. To apply to science such an epithet as "Christian" involves a total misunderstanding of what science is. Science can do no more than investigate *all* truth, nor can it, consistently with its essential nature, do less.

In the matter, however, of relieving human suffering and prolonging human life, what is the record? The record is that since science obtained a secure footing in the world it has been steadily making better conditions of life for mankind; that it has

almost extirpated certain diseases and greatly mitigated the virulence of others; that its prophylactic methods in regard to epidemics that used periodically to scourge the most civilized nations are of proved and signal efficacy; and that by the use of anæsthetics and antiseptics it has assuaged an absolutely incalculable amount of human anguish. A writer in a recent number of The Nineteenth Century, describing the progress of medicine and surgery during the last sixty years, quotes an account given by a distinguished physician of his own experiences in undergoing a surgical operation before the days of anæsthesia. The passage is a painful one, but we shall be pardoned, we hope, for reproducing it, as it is very pertinent to the occasion:

"Of the agony occasioned I will say nothing. Suffering so great as I underwent can not be expressed in words, and thus fortunately can not be recalled. The particular pangs are now forgotten; but the black whirlwind of emotion, the horror of great darkness, and the sense of desertion by God and man, bordering close upon despair, which swept through my mind and overwhelmed my heart, I can never forget, however gladly I would do so. . . . Before the days of anæsthesia a patient preparing for an operation was like a condemned criminal preparing for execution. He counted the days till the appointed day came. He counted the hours of that day till the appointed hour came. He listened for the echo on the street of the surgeon's carriage. He watched for his pull at the door-bell; for his foot on the stairs; for his step in the room; for the production of his dreaded instruments; for his few grave words and his last preparations before beginning. And then he surrendered his liberty and, revolting at the necessity, submitted to be held or bound and helplessly gave himself up to the cruel knife."

Less than fifty years ago these were daily experiences; and whence did relief come? From any hocus-pocus speculations upon mind and matter? From any looking away from phenomena and trying to disbelieve them out of existence? No, but from assuming the reality of phenomena, and bringing a material agent to bear on a physical condition. True, theological objections were raised to this new and most beneficent extension of medical science; but it would have taken more theology than was contained in all the catechisms to make the world renounce the new hope thus tendered to it. And now, if further progress is desired, can any sane and honest man doubt the direction in which it is to be sought? What science has done is but an earnest of what it will yet do. All that is needed is a patient following out of her methods—the first of which is a careful measuring and recognition of facts as they are—in order to reach forward to all possible good. We can only trust that many minds now entangled with "Christian science" will work their way to a knowledge and love of true science. If they do, they will gain a sense of intellectual emancipation such as they never before experienced; they will know also of the doctrine that its foundations are in the truth of things, and that its mission is the healing and regeneration of the human race.

THE WORLD AS IT IS.

In these bright summer days, when most of us get glimpses of rural scenery and not a few are privileged to enjoy it for days and weeks together, it would be fitting if we were occasionally to reflect how

wonderfully this world which we find so beautiful has become adapted to us and we to it. We are too much accustomed to take the world as it actually exists for granted as something that always has been and that always will be. We are apt to forget that the whole human period is but as a narrow fringe upon the vast space of geologic time, and that the world before the advent of man was a very different world from that in which we live. We talk of the everlasting hills and of the primeval forest, but to the geologist the hills are not everlasting and the forest is but a creation of yesterday. The poet Tennyson has caught the true geological standpoint in the following fine verses of In Memoriam:

There rolls the deep where grew the tree.
O Earth, what changes thou hast seen!
There, where the long street roars, hath been
The stillness of the central sea.

The hills are shadows, and they flow
From form to form, and nothing stands;
They melt like mist, the solid lands,
Like clouds they shape themselves and go.

The earth, which we find to-day bright with varied hues, vocal with innumerable sounds, rich in fruits and fragrant with odors, lay for an almost incalculable period of time destitute, or all but destitute, of color, soundless save for the noise of wave and tempest, and with no promise as yet of the rich profusion of vegetable and animal forms that now diversify its surface and fill it with the thrill and manifold activities of life. We often speak of man as "the heir of all the ages," but not often, probably, do we pause to realize the significance of the word. We talk of evolution, but seldom make any due effort to grasp the plenitude and grandeur of the thought. These senses of which we have the use, and each of which brings a different world within our ken, whence are they? It seems so natural to see; it seems so natural to hear, to touch, to smell, to taste, that we forget through what slow processes, by what an incalculable number of slight accretions and delicate modifications these wonderful channels of knowledge and sensation have been made for us. We go back through the ages and we come to a sightless, voiceless world. For a period probably as long as all the rest of geological time the only forms of life were protozoa. Sight was developed among the wonderful crustaceans of the Silurian period, but as yet there were no organs of hearing. The first stridulation of an insect wing was heard (if it was heard) in the Devonian age, the birth epoch of the first vertebrates, fishes; but long ages had to pass before the first bee hummed over a flower or the first butterfly fluttered its wings in the sunshine. There were no flowers in the Devonian age nor yet in the ensuing Carboniferous, though in both there was a mighty vegetation.

The earliest birds belong to the Cretaceous period—the classic age of reptiles. They were not songsters, however—far from it; nor were they beautiful to look upon, for they had strong points of affinity with the reptile tribe from which there is reason to believe they were developed. It was not till well into the Tertiary period that birds as we know them began to trill and twitter in the woods. It was in the same period that the mammals began to take masterful possession of the earth. The earliest mammalian forms were not the perfect organisms as regards form or activity with which the modern world is familiar, and many of them had but a comparatively short existence. In the Tertiary period, however, there was a vast outbreak of insect, bird, and mammalian life, and now began in earnest the struggle for existence—that struggle

which has carried existing forms of life to so high a point of perfection.

In the Quaternary period appears man. Whence? How? These are questions which it is impossible not to ask, but for satisfactory answers to which we may have to wait a long time. All analogy leads us to believe that man was developed from some humbler form of life. Upon him was bestowed the great and unique gift of a superior thinking faculty, the material organ of which is undoubtedly his brain. Man "looks before and after," and if he also "sighs for what is not," that too is a notable mark of his superiority. Other animals learn from experience, but to man it is given sometimes to anticipate experience. He sees things in their relations, and a relation becomes to him as real as the thing itself. His thought is, therefore, compared with the thought —if we may so characterize it—of the nearest to him of the lower animals, like a higher algebra compared with the processes of a very elementary arithmetic. His senses are not in general keener than those of the lower animals. The latter, indeed, often surpass him in this respect, but what he sees or hears is for practical purposes increased a hundredfold by what he is able to infer therefrom. He knows what to look for over a wide range of possible phenomena, and separates the significant from the insignificant.

So equipped, the human race has entered upon a world already prepared in a wonderful manner for its habitation. Many were the struggles it had to endure in the early ages; but society was formed, and man, by the aid of his fellow-man, triumphed over all his foes—triumphed, at least, sufficiently to perpetuate his race and hand down from generation to generation a slowly bettering inheritance. And now, in these later days, the human individual in a civilized land can look forth on scenes of peace and plenty and beauty. In this advanced stage of the physical world the song of the bird, the hum of the bee, the gleam of the firefly, the colors and odors of flowers, the golden ripple of the cornfields, the tints and flavors of autumn fruits, are his richly to enjoy. He gazes at the clouds, at the stars, at the brimming tide of the ocean, with thoughts that have been widened and strengthened by the mental efforts of a thousand buried generations. If there is any duty, therefore, that is incumbent on the man of to-day it is to know something by his own efforts of the wonderful and beautiful world in which he has so great an inheritance. Not without feelings of love should he gaze on the landscapes which the labors of his forefathers have helped to make beautiful; and not without feelings of reverent interest should he regard the daily play of natural forces in the world around him. We should all be students in our way; it may not be much that we can do, but some little plot or corner of the great field of knowledge we should religiously till, that we may add, if not a sheaf, at least a blade to the harvests which the workers are bringing in.

Who can reflect, however, on the beauty and harmonies of Nature without remembering that human society is far as yet from having reached its perfect harmony! If there is a natural landscape there is also a human landscape; and here the blots are many, so many that it is difficult not to be discouraged at times, even when making full allowance for all the good that society has realized and represents. The man of strenuous mind will not, however, be discouraged. He will acknowledge the existing evil, and will patiently seek

out remedies in the storehouse of natural knowledge. Nature duly interrogated will supply the remedy. For the world apart from man she has established the beneficent law of natural selection; for man also she has established that law, but in the heart of the human being she has implanted, as an adjunct to it, the law of justice. The full scope of that law has never yet been adequately understood by any human society; and four fifths of the legislative tinkering that is done by our politicians springs from a simple ignoring of it. We wish most strongly that every man of science, instead of turning away from politics as something most alien to his studies, would make a duty of asking himself this question: What light do my studies throw upon the questions, or some one or other of the questions, that are now most debated in the political world? It may be that the particular facts with which a given man of science deals may have no visible bearing on any question of the day; but what about the scientific methods he pursues—have they no bearing? We are convinced that light must come some day from the direction of science. It is for the men of science to see that they do not fail in their duty in this most important respect.

Scientific Literature.

SPECIAL BOOKS.

In these two handsome volumes* the distinguished Director General of the Geological Survey of Great Britain and Ireland traverses ground once hot with subterranean fires but long since cooled, and traverses, too, a field in science formerly heated by the fires of controversy which have burned themselves out like the ancient volcanoes. Werner's "geognosts," or the Neptunists, as they were dubbed, who in the latter part of the eighteenth century maintained the aqueous origin of basalt, were converted or silenced in the early part of the nineteenth and have left no followers. There are no more Plutonists, moreover, for all geologists are of that stripe. The author has designed this work as a summary of what has now been ascertained regarding the former volcanoes of the British Isles. "The subject," he says, "has occupied much of my time and thought all through life. Born among the crags that mark the sites of some of these volcanoes, I was led in my boyhood to interest myself in their structure and history. The fascination which they then exercised has lasted till now, impelling me to make myself acquainted with the volcanic records all over our islands, and to travel into the volcanic regions of Europe and western America for the purpose of gaining clearer conceptions of the phenomena." The British Isles afford a large and varied body of evidence regarding the progress of volcanic energy in former ages. The geological record is remarkably complete in those islands, and has been very carefully studied. The position of Britain, on the margin of a great ocean basin, is one in which volcanic action is apt to be most vigorous and continuous. Furthermore, denudation has made the extensive volcanic record of this

* The Ancient Volcanoes of Great Britain. By Sir Archibald Geikie, F. R. S., D. C. L., D. Sc. In two volumes. New York: The Macmillan Co. Price, $11.25.

region fully accessible to observation. The proofs of the existence of old volcanoes consist in part of the lavas, agglomerates, breccias, and tuffs erupted from the earth's interior. The walls of the orifices through which these materials have reached the surface are also to be found, but often more enduring than these is the column of hardened material filling the once belching chimney of the volcano. Molten material that does not reach the surface is often intruded from below into vertical fissures, forming dikes, or spreads out in horizontal cavities, forming sills and laccolites. Sir Archibald describes all these kinds of evidence in his early chapters, and then enters upon a description of the ancient volcanic localities of Britain in the order of the geological ages. The Lewisian gneiss in northwest Scotland affords glimpses of probable volcanic activity at the very beginning of geological history, and there is other similar evidence dating from pre-Cambrian times. In South Wales a remarkably varied display of British Cambrian volcanic rocks has been preserved. Coming to Silurian time, we find a singularly complete volcanic chronicle. In Merionethshire, Pembrokeshire, Caernarvonshire, Anglesey, the Lake District, and the eastern parts of Ireland the history of eruptions is unmistakable. During the Old Red Sandstone period groups of volcanoes rose in long lines from the waters of most of the lakes, and threw out lava and ashes over tracts hundreds of square miles in extent. Only the earlier half of the Carboniferous period was productive of volcanoes in Britain, but vast remains of these are to be seen in the puys and plateaus of Scotland and in numerous dikes, sills, and bosses. After the last of the Palæozoic eruptions ages of quiescence elapsed before volcanic activity recommenced in Tertiary time. Remains of Tertiary volcanoes are to be found chiefly in the isles of Skye and Mull and in northeastern Ireland. In summarizing the studies here presented our author calls attention to the distribution of the ancient volcanic eruptions along the western margin of the European continent, thus conforming to the tendency of modern volcanoes to range themselves along continental borders. From Archæan time to the Tertiary volcanic activity was remarkably persistent in the British Isles. It is evident from a study of the British examples that where no fissures existed in the visible part of the earth's crust communication from the internal magma to the surface was effected in hundreds of instances by explosions which blew out an orifice. Besides the manner in which the vents were formed, the kind of materials ejected, the mode of closing of the chimneys, and the manifestations of the final efforts of the volcanic force are all to be read in the grand chronicle of the rocks. Seven colored maps and nearly four hundred figures illustrate the work.

While polar auroras may be classed among the more spectacular phenomena of the heavens, they do not force themselves upon our attention as storms, lightning, shooting stars, and eclipses do. They have been studied only under difficulties, for they do not occur frequently in temperate regions as lightning does, and the time when preparations should be made to observe them can not be foretold as with eclipses. It is interesting to have laid before us, in the latest volume of the International Scientific Series, the knowledge that has been gained in the face of such obstacles.* Much

* The Aurora Borealis. By Alfred Angot. International Scientific Series, Vol. LXXVII. New York: D. Appleton & Co. Pp. 264, 12mo. Price, $1.75.

of the popular interest which auroras have aroused is due to the varied and often changing forms that they assume. Their protean shapes have caused people of earlier times to see in them bloody flames, armies in the clash of battle, or furiously riding Valkyries. They may appear as faint lights without defined shape; if more distinct, they are seen to have the form of rays converging upon some point in the sky, or of more or less clearly defined arcs, or of bands which fold over on themselves like a curtain, and are called draped auroras. M. Angot describes many variations of these typical shapes, and presents plates on which some of the most interesting are depicted. The vertical rays of which most auroras seem to be made up move both horizontally and vertically, and as they are usually in constant motion an aurora may readily change from one typical form to another. While the light from most auroras is white, the rays are frequently tinged with yellow, and are sometimes red at the lower extremity and green at the upper. The nature of the auroral light is not established, although the spectroscope and polariscope indicate that it is emitted by luminous gases. It seems probable that a slight rustling or crackling sound accompanies auroral displays, but our author finds no credible evidence of any odor. While many auroras of small extent appear only as local phenomena in high latitudes, others are visible to within twenty degrees of the equator. It seems to be usual for an aurora australis to occur simultaneously with an aurora borealis, notably on February 4, 1872, when the globe, with the exception of an equatorial zone of about forty degrees, was enveloped in polar lights. The periodicity of auroras has been studied with the result of establishing a diurnal and an annual period, and a period of a little more than eleven years. Less exactly determined are the periods of about twenty-eight days, and of about fifty-five years and a half. Those of twenty-eight days and eleven years seem to connect the auroras with sun spots. The relations of the aurora with meteorological phenomena and with terrestrial magnetism have also been investigated. The data obtained from researches on the foregoing questions have given rise to many theories as to the cause of auroras. Our author states several hypotheses that have been made clearly untenable by recent advances of knowledge. One of these is the idea of Mairan that auroras occur when the earth passes through the cloud of matter that produces the zodiacal light, some of this matter falling into our atmosphere and becoming ignited. The reflection of sunlight from particles of ice in the atmosphere is another cause suggested, and still another regards the light as a sort of fluorescence. Our author treats with more respect, although positively rejecting it, the theory first definitely stated by Dalton, that the light is given off from silent electric discharges between the upper and lower strata of the atmosphere, these discharges being conducted through ferruginous dust falling upon the earth from space. He gives also several electric theories, among which he regards that of Edlund as the most satisfactory. Edlund starts from the phenomena of unipolar induction—the production of currents in a metallic sheath surrounding a magnet when the sheath is rapidly revolved. The general phenomena of terrestrial magnetism justify regarding the earth as such a sheath. Electricity, according to this theory, is constantly being carried by molecules of air from the equator to the poles, where it accumulates and from time to time returns to the ground by slow discharges which produce auroras. M.

Angot concludes with a statement of the plausible but undemonstrable theory recently proposed by Unterweger. To the body of the work is appended a Catalogue of the Auroras seen in Europe below latitude 55° from 1700 to 1890, filling eighty-eight pages. A large part of the data employed in this volume were gathered in Lapland during the winter of 1838–'39 by the expedition on board the Recherche, others are taken from Nordenskiöld's Voyage of the Vega, and still others from a variety of sources which the author indicates. The book will go far toward giving the general reader clear ideas in place of fragmentary notions.

GENERAL NOTICES.

THE evolution of special lines of culture is a most interesting study. Tylor's Primitive Culture and Early History of Mankind have been followed by a host of books of a general or a special kind, in which almost everything has been "traced." Curiously, however, there is no serious work upon art evolution—using the term art in its wide sense to include all the fine arts—Tylor's *arts of pleasure*. The book before us, which is the fourth in the Anthropological Series, undertakes to study the Beginnings of Art.* Dr. Grosse holds that in modern savages we may safely hope to find similar crude beginnings to those made by primitive man long ago. He denies our right to draw illustrations from among barbarous or civilized peoples, and insists upon taking them from savages only. In marking out culture stages, he emphasizes the mode of gaining food supply, and considers those peoples only as savages—*Naturvölker*—who depend upon hunting and wild food. There are really few such peoples: the Australians, Andamanese, Bushmen, Fuegians, Botocudos, and Eskimos are about all. From these Dr. Grosse collects his examples of primitive art forms. There are two classes of arts—arts of rest (i. e., plastic and graphic) and arts of motion (i. e., the dance, poetry, and music). The former appear to begin with ornamentation and personal decoration, but real representative art also begins early. The arts of the dance, poetry, and music are usually closely connected in savage life. Not only does Dr. Grosse try to show how the various art forms began, he also tries to show how the art reacts upon the artist; he traces the social influence of arts. This is one of the strikingly original features of the work. The book is a translation from the German; the translator has done his part faithfully. The book is perhaps the best that has so far appeared in the Anthropological Series.

Prof. *Tarr* has not undertaken to make this book* a perfectly balanced treatise by giving each part of his subject just the prominence due to its intrinsic value. He has made a book for a special purpose—the instruction of pupils in high schools—and has proportioned it as he deems best for that purpose. He believes that stratigraphical geology should be, for the most part, left to a more advanced stage than that of the secondary school, and so has included only its main truths and some examples of its evidence here. But with structural and dynamical geology, he says, "the body of fact necessary for elementary understanding is not so great nor so difficult to grasp. The teachings of these truths are illustrated on every hand, and, in fact, some of them are already familiar to the pupil before he enters upon the study. They deal with phenomena in the midst of which we dwell, and hence should become a part of the mental possessions of every high-school pupil." Accordingly, he devotes about three fifths of the volume to the dynamic side of the subject, and gives a hundred pages to structural geology, leaving also a hundred for the stratigraphical division. In the structural portion he gives most attention to describing the minerals and rocks that occur extensively in the earth's crust, and

* The Beginnings of Art. By Ernst Grosse. The Anthropological Series. New York: D. Appleton & Co., 1897. Pp. xiv + 327, 16mo. Price, $1.75.

* Elementary Geology. By Ralph S. Tarr. New York: The Macmillan Co. Pp. 499, 12mo. Price, $1.40.

by the use of simple language and many photo-engravings of well-selected specimens he makes their nature remarkably clear. In the dynamical division the processes of weathering, erosion, deposition, stratification, metamorphism, and the formation of mountains, volcanoes, etc., are made clear by the same means. The stratigraphical division probably contains as much material as the pupil is likely to assimilate. It opens with an explanatory chapter on the uses of fossils, then the kind of life that prevailed in each geologic age is described with the aid of figures of fossils and ideal landscapes of the several ages, and the account closes with an outline of the changing geography of the United States from Archæan to Cenozoic time. Throughout the work the author is careful to distinguish important doctrines that are proved from those that remain hypothetical. The volume is printed in large, clear type, and contains two hundred and sixty-eight figures and twenty-five plates, including a colored geological map of the United States.

His various investigations and writings, extending over a term of years, have well equipped Prof. *Israel C. Russell* with material for making a book on the North American glaciers.* In the volume which he has recently put forth he not only enumerates and describes the glaciers of this continent that have been explored, but he also explains the theory and depicts the behavior of these solid rivers, so that the reader untrained in science may follow him. The glaciers of the Alps, being in a region that is surrounded on all sides by thickly populated countries, have been the most studied. But Prof. Russell points out that "North America offers more favorable conditions for the study of existing glaciers and of the records of ancient ice sheets than any other continent. Of each of the three leading types of glaciers thus far recognized—namely, the Alpine, Piedmont, and continental—North America furnishes magnificent examples." After describing the glaciers of each locality from the Sierra Nevada Mountains to Greenland, our author discusses the climatic changes indicated by the glaciers of North America and the evidence that the great ice sheets are retreating. The how and why of glacier movement, and the life history of a glacier, form the subjects of the two closing chapters. The volume is illustrated with twenty-two plates and ten smaller figures.

"There is perhaps little that need be said prefatory to a work of this character," say the authors of a volume of problems, and for the same reason a description of the work can not be long.* The authors have prepared it in the belief that any text in physics needs to be supplemented by problem work in considerable variety. An introduction contains the tables of physical constants required in working the problems, while tables of logarithms, sines, etc., and a list of answers appear at the end of the volume. The use of directed quantities, graphic methods, averages, and approximations is briefly set forth in several preliminary chapters. The problems are divided among the subjects of mechanics, solids, the behavior of liquids and gases, heat, electricity, magnetism, sound, and light. A few problems have been inserted which can not be satisfactorily worked by other than calculus methods, while here and there graphic methods have been suggested that may be profitably extended by the student. Occasional questions not requiring numerical answers have been asked.

The fourth volume of the American History Series deals with a period of growth. Between 1817 and 1858 the territory of the United States was increased by the acquisition of Florida, Texas, and Oregon.† The population of the older States, pushing toward the west and southwest, made settlements and organized communities in the hitherto unorganized territories. In this task they were largely re-enforced by immigrants from Europe. It was a period also of the growth of pent-up forces, which later produced the outbreak of the civil war.

* Glaciers of North America. By Israel C. Russell. Boston: Ginn & Co. Pp. 210, 8vo. Price, $1.90.

* Problems and Questions in Physics. By Charles P. Matthews and John Shearer. New York: The Macmillan Company. Pp. 247, 8vo. Price, $1.60.

† The Middle Period, 1817–1858. By John W. Burgess. New York: Charles Scribner's Sons. Pp. 344, 12mo. Price, $1.75.

The question as to the policy of a United States Bank and that of the right of a State to nullify a Federal law were settled in this period. But the slavery question only grew more pressing, the several attempts to adjust it all proving ineffective. Prof. *Burgess* has given us a history of public affairs in this period drawn from original sources. He has made a special effort to shun the bias of prejudice and preconceptions, to refrain from glorifying lawlessness in behalf of whatever opinion it was committed, and to credit men and communities with whatever of integrity and sincerity they actually possessed, instead of rating them as gods or demons, according to their position on some one question. Our author has confined himself to those events which, in his opinion, are significant of our progress in political civilization, and he has hoped to so treat them as to remove the traces of misunderstanding between the North and the South which still linger. He does not attempt to do this by conceding that the South was as much right as the North, but takes the position that the South was in error in secession and rebellion, and must acknowledge its error before complete national cordiality can be established. The volume contains five maps, tables of electoral votes in detail, of cabinet officers, of chronology, of bibliography, and a full index.

Since the days when Redfield and Espy and Ferrel struggled with the larger theoretical questions of winds and storms the advance of the science of meteorology has been remarkable. Its practical applications have not lagged behind, being, in fact, the chief motive for the support that has been given to the study of the science. Until lately little has been done toward popularizing the knowledge that has been gained in this field. In a book now before us Dr. *Waldo*, formerly a professor in the United States Signal Service, has undertaken to give an outline of the science in simple form.* The first of the meteorological elements that he treats is temperature. He tells how the atmosphere gets its heat and how temperatures vary in different places and at different times. This chapter is illustrated by many charts on which the average and the extreme temperatures of the earth's surface are indicated. The variation and distribution of air pressure are similarly treated, and a brief discussion of winds naturally follows. The author considers the moisture of the atmosphere with reference to three steps in the cycle that it passes through—as distributed through the air whether invisible or in cloud and fog, as precipitated, and as taken up again from the earth by evaporation. After briefly calling attention to some optical and electrical phenomena, the author returns to movements of the air, describing first the larger circulatory movements, then the secondary circulation in the form of cyclones and local and miscellaneous winds. There is a chapter on weather predictions—the part of meteorology having most popular interest—and one on climate in general, which is followed by an extended analysis of the climate of the United States. The book is suitable for use as a text-book or for general reading. Its mechanical form is attractive, and it is illustrated with one hundred and twenty-one diagrams and other figures.

Prof. *Johnson* has added to his valuable works on engineering subjects a very complete treatise on structural materials.* In his preliminary chapters he describes the behavior of materials under the several kinds of stress, the matter here given being designed to supplement that usually contained in text-books on applied mechanics. A second division of the work, which the author intends to be read by engineering students if they do not get the information in other ways, deals with the manufacture and general properties of cast and wrought iron, steel, and other metals, lime, cement, brick, and timber. The attention given to the structural properties of wood is a feature of the work. Little accurate information on this topic had been available until the Forestry Division of the United States Department of Agriculture began the systematic study of timber and timber trees some five or six years ago. Prof. Johnson has been intimately connected with these investiga-

* Elementary Meteorology. By Frank Waldo, Ph.D. New York: American Book Company. Pp. 373, 12mo. Price, $1.50.

* The Materials of Construction. By J. B. Johnson. New York: John Wiley & Sons. Pp. 787, 8vo. Price, $6.

tions, having had entire charge of the mechanical tests. In the chapter on the characteristics of wood a list of over a hundred timber-producing trees of the United States is given, with a brief description of each and a figure of its leaf and fruit. The part of the volume upon which the author expects the student to put his serious work relates to the methods of applying tests of materials and to the machines employed in testing. This is followed by a group of chapters relating to the mechanical properties of the materials of construction as revealed by actual tests, in which the author expects that selections will be made for students according to the course they are taking. Among the special subjects here treated are the strength of iron and steel wire and wire rope, and the magnetic testing of iron and steel. The volume is illustrated with six hundred and thirty-five figures and diagrams and eleven plates. The author has avoided the use of tables, preferring to arrange in diagrams the data often appearing in tabular form. There are appendices relating to the micrographic analysis of iron and steel, to attempts to secure uniform tests of materials, and to standard specifications for structural steel.

Our material for the study of infant psychology has received a carefully prepared addition in *The Mental Development of a Child*, by *Kathleen Carter Moore*, issued as a monograph supplement to the Psychological Review (Macmillans, paper, $1). This is a record by a mother embracing the manifestations of activity and of change in her own child, and the conditions under which each action or change was manifested. This material is supplemented by summaries reviewing the mental condition of the child at given periods. The first of these reviews covers all lines of activity; later, when there was more to record, each set of activities is summarized separately. The observations are grouped under the four chief heads Movements, Sensations, Ideas, and Language, and many of them, especially those relating to language, are tabulated besides being described.

The sixth volume of the series in Philology, Literature, and Archæology of the publications of the University of Pennsylvania is devoted to *Researches upon the Antiquity of Man*, by *Henry C. Mercer* (Ginn, $2). The contents comprise descriptions of excavations made and articles found in several localities, and are introduced by a discussion of the chipped stone implements which are the most numerously preserved examples of the handiwork of savage man. The first finds herein described are those made at an ancient argillite quarry and blade workshop on the Delaware River. Here were found one hundred and seventy-four hammer stones, large numbers of "turtle backs" and chips, and a few miscellaneous objects. An account of the exploration of an Indian ossuary on the Choptank River, in Maryland, is given by Mr. Mercer, with a description by the late Prof. Cope of the human bones discovered there, and an examination by R. H. Harte, M. D., of traces of disease in the bones. There are also accounts of explorations of aboriginal shell heaps on York River, Maine, where traces of cannibalism were found; of a rock shelter in the Delaware Valley; and of Durham Cave, in Bucks County, Pennsylvania. The text is illustrated with fifty-one figures and diagrams.

The *Philosophical Society of Washington* has issued a substantial volume as the twelfth in its series of *Bulletins*, containing the publications of the society from 1892 to 1894. The address of Prof. T. C. Mendenhall, as retiring president, on The Uncertainty of Conclusions, and that of G. K. Gilbert, also as retiring president, on The Moon's Face, are included in the contents, and among the more extended papers are The Origin of Igneous Rocks, by Joseph Paxson Iddings; Summer Hot Winds on the Great Plains, by Isaac Monroe Cline: and Mean Density of the Earth, by Erasmus Darwin Preston. Several of the papers are accompanied by views or diagrams. There are obituary notices of eleven members, those of Garrick Mallery and James Clarke Welling being accompanied by portraits.

An elementary text-book on *Electricity and Magnetism* has been prepared by Prof. *Charles A. Perkins* (Holt, $1.10), which, while it acknowledges the impossibility of such a work being up to date, still aims to implant initial conceptions that are in ac-

cordance with the best modern theories. A brief introductory chapter on dynamics gives some of the general ideas relating to force which are applied later to the special subject of the volume. The usual topics are taken up, and the language and the amount of mathematics employed adapt the book to college preparatory or freshman year classes. There is a directness and conciseness about the mode of treatment that contrasts with the formal and encyclopedic character of some works of a generation ago, which are still in use. The volume contains one hundred and sixty-five diagrams and figures of instruments.

The contrast between old and new methods in education can not be better illustrated than by comparing an old-fashioned primer with *Our Little Book for Little Folks*, arranged by *W. E. Crosby*. In the latter we do not find an alphabet on the first page, followed by the most mechanical of word exercises, with a few crude black pictures interspersed among them. We have, instead, little sentences in which some words are in vertical script, while others are represented by well-drawn pictures. Some pages are in white on black, as they would appear on a slate or blackboard; some of the lessons consist of verses set to simple music; at intervals through the book are plates on which appear in their natural colors the objects drawn in black and white on the reading pages; there is a frontispiece plate of seven national flags, and a plate at the end on which the three primary colors are shown and the three secondary colors produced by combining the primary; another feature is the many simple outline figures which the child can copy with the pencil or by laying sticks together. If this is not a "royal road" to learning it is at least a flowery path. (American Book Company, 30 cents.)

Those desirous of having a popular volume from the pen of the late *G. J. Romanes* will be pleased with the collection of *Essays* which Prof. C. Lloyd Morgan has prepared (Longmans, $1.75). Prof. Morgan has chosen ten essays which Mr. Romanes had contributed to various English and American reviews, only one of them, that on the Origin of Human Faculty, in Brain, being taken from the pages of a technical journal. Several of the essays deal with psychology, which was the especial field of the author, for example, The Darwinian Theory of Instinct, Mind in Men and Animals, Mental Differences between Men and Women, and Hypnotism, while in those treating of other subjects, as folklore in the essay on Primitive Natural History, hygiene in the one on Recreation, or disease in that on Hydrophobia and the Muzzling Order, the philosophical insight of the man into mental states and operations, and his power of placing his thoughts clearly before the reader are everywhere apparent.

The second and concluding part of the reports secured by the Secretary of the Treasury on the *Condition of Seal Life on the Rookeries of the Pribilof Islands* has been issued as a Senate document. This publication contains descriptions of the condition of the rookeries in 1893, 1894, and 1895, by C. H. Townsend, a similar description for 1895 from an examination made by F. W. True, and an account of the mode of seal hunting practiced by a Canadian sealing schooner, as reported by A. B. Alexander, all of these writers being officers of the United States Fish Commission. All these reports furnish conclusive evidence as to the large proportion of female seals in milk that are killed, the consequent starvation of thousands of nursing pups, and the rapidly progressive reduction in the numbers of seals on the rookeries that is going on. The volume is fully illustrated with maps and photographic views.

The author of *America and the Americans, from a French Point of View*, draws no very flattering picture of our social life and institutions. It has been suggested that he is not a Frenchman at all, but an American who under this convenient disguise tells his countrymen some disagreeable but wholesome truths about themselves. The book is nowhere on the title-page mentioned as being a translation, a fact which seems to favor this view. Whoever the author may be, he shows himself intimately acquainted with the peculiarities and customs of the country he so severely criticises. Evidently a man of culture who knows men and manners on both sides of the Atlantic, he touches with a caustic pen on the less lova-

ble characteristics of our social and political life. He notes down his first contact with our people on the journey from Liverpool to New York, and his impressions of the metropolis on its social side, as revealed in public and private functions. He devotes a chapter to the American business man, one to politics, and one to the newspaper. He pays flying visits to Boston, Concord, Plymouth, Cambridge, and Chicago, the Black Belt, and to various summer resorts. Perhaps the most biting chapter is that on Young America, as indeed the difference in rearing children here and on the other side with its well-known results most forcibly strikes a foreigner. The author dubs our children "young Saxon Bedouins, the most terrible of all *enfants terribles*." The book may not flatter our vanity, but as a fearless criticism on some of the crudities of western civilization it should open our eyes a little more to our own shortcomings. (Charles Scribner's Sons, 1897, $1.25)

The value of Mr. *Frederick J. Brown's* statistical study of *The Northern Movement of the Colored Population* rests, it seems to us, not so much upon any evidence it affords as to a definite or very great movement northward, as upon its explanation of the tendencies of the movements of the negroes. They seem to act very much as the whites do—to go where they can do best, north, south, or to other parts of their own region of residence. They are governed by the prospect of employment, by social motives, and by the promise of good treatment—drawn, not driven, as the author expresses it in one place. A goodly number come north, and goodly numbers go in the other directions (Baltimore: Cushing & Co. Price, 25 cents).

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Fragments of Science.

The Swift's Night Flight.—The curious night flight of the swifts is described in Knowledge by C. A. Witchell: "The sun has set and most of the small birds have retired for the night, though the sparrows are still noisy in the creepers on the house. Most of the swifts are flying low over the meadows, but some are in the sky, and of these a few are chasing others, and performing those magnificent swoops by which it appears that the males drive the females to their nests. Certain it is that the pursuing birds (always acting singly) chase particular individuals, whose course they follow at a greater altitude, but always with the intention of finally descending in a falconlike swoop at the lower bird, who, anticipating the attack, swerves downward and finally plunges headlong. The swishing sound produced by the descending swifts can be heard at a considerable distance. . . . At about forty minutes after sunset (whether in June or July) the group of swifts begins to whirl round and round, like a mob of rooks; but again and again the cluster breaks up in a pursuit and a mad, noisy rush across the sky. Yet the birds are gradually attaining a higher position, and their screaming becomes the less noticeable. Their wings often have a tremulous motion, reminding one of the flight of an ascending skylark. Still, there is no deliberate upward flight, only a succession of swoops and rushes, terminating at increasing distances from the ground. The birds keep fairly together, and not one descends to the houses; but it may be the cluster is joined by another group, coming you know not whence. Dusk is beginning to fall, and even the sparrows are silent, but the cries of the swifts can yet be faintly heard. The birds may now be easily lost sight of altogether, especially if there be no white, fleecy clouds high overhead to throw into relief the whirling black dots in the sky. Now is the time

to use a field glass or small telescope, and, having once found the birds with it, to keep them in the field as long as possible. . . . Up and up they go, appearing smaller each moment till even the power of the glass is overcome, and the tiny specks vanish for the night. As you drop your arms wearily you find that the dusk has fallen, the bats are out, and the evening mists are rising; but the swifts must now be nearly on a level with those remote flecks of cloud which, at an immense height, are yet snowy in the sunshine."

The Light of Fireflies.—In experiments on the properties of the light of fireflies, Prof. H. Muraoka used plates of copper, aluminum, zinc, and brass of equal size, separated from the photographic plates on which they were severally laid by a layer of cardboard having a cross-shaped piece cut out of the center; wrapped the whole with three or four thicknesses of black paper, and exposed the bundle to the light of several hundred fireflies. His purpose was to learn whether the light from the insects after filtration through the black paper could penetrate the metals and affect the photographic plate, and to determine the relative transparency of the substances used. To his surprise, the parts of the photographic plate under the cardboard were most darkened, while those under the cross-shaped holes remained clear. The light of the insects seemed to behave very much like ordinary light, but, after "filtration," acquired properties similar to those of the Röntgen or the Becquerel fluorescent rays—properties apparently resulting from the filtration. Further, the filtered rays appeared to exert a peculiar action toward the cardboard—called by the author a suction phenomenon—similar to that of the lines of magnetic force upon iron. The properties of the filtered rays seemed to depend on the filtering substances, probably upon their thickness. They exhibited properties of reflection, but those of refraction, interference, and polarization were not observed, although the author believes that they exist. Their properties, generally, appear to be between those of the ultra-violet and the Röntgen rays. The insects used in the experiments had two or three rows of luminous spots on their under body; but the photographic plates were affected by the whole body as well as by the luminous spots, so that a complete image of the insect was formed when it was put upon the plate, the figure of the luminous part being, however, plainer than the rest.

Dust.—Micro-organisms are the great producers of disease, and dust is the chief carrier of micro-organisms. If there is any one ubiquitous thing, it is dust, and yet, notwithstanding its dangerous contents, it is being continually poked up, so to speak. As soon as the housemaid is up, it is hustled and dusted into the air, so that by the time the family is astir any germ which may have quietly settled in some corner where it could do no harm is floating about in the air, ready to appropriate any convenient and moist resting place, such as the human lungs or a bit of the breakfast, which will shortly carry it into one of the inmate's systems. The street-cleaning department, too, spends much of its energy in simply stirring up the dust about the streets; a little of it is carried off in carts each day, but every particle thus removed has probably been previously stirred up and allowed to settle a dozen times. The carpets and upholstery of modern houses were apparently designed as dust collectors. It is impossible to clean thoroughly a thickly upholstered sofa or chair, and almost as difficult to get a modern carpet or rug clean; these articles always contain more or less dirt, which in the case of the carpet is superficially stirred up at each sweeping. In fact, the reckless way in which house and street cleaning are handled is really appalling. Dusting should always be done with a damp cloth, and carpets cleaned by a closed sweeper well filled with wet tea leaves. The street-cleaning problem is simply a question of water supply. A thorough flushing of the streets once or twice in twenty-four hours offers a simple hygienic and thorough solution.

Pocket Gophers.—The pocket gophers, or *Geomyidæ*, according to G. Hart Merriam's description, are North American animals exclusively, and most at home in the western United States and Mexico. Their whole organization is modified to suit a life underground. They are short-legged, thick-

set animals, with no appreciable neck or external ears, and very small eyes. The feet are adapted to digging, the fore paws in particular being very strong and armed with long, curved claws, while the sides of the toes are lined with rows of bristles that prevent the dirt from passing between the fingers. The tail is moderately long, thick, fleshy, usually hairless, and sensitive to the touch. In working under the earth the animals loosen the ground with their upper incisors, while they keep their fore feet in active operation in digging and pressing the earth back under the body, and their hind feet in moving it still farther backward. As the dirt accumulates in its rear the animal turns in its burrow and, bringing its wrists together under its chin, with the palms of its hands held up, forces itself along by its hind feet, pushing the earth outward. All the pocket gophers have external cheek pouches, which are used for carrying food. They are great hoarders, and fill their storehouses with vastly more than they consume. The cheek pouches reach back as far as the shoulder. A captured animal filling its pouches after a meal made motions so rapid that they were hard to observe. If a piece, say of potato, too large to go in the pouch, was given him, he would grasp it with both paws and pry off small bits with his long lower incisors, then raise himself a little on his hind legs and hold the fragment between his fore paws while eating previous to putting away what was left. Small pieces were disposed of promptly; others were trimmed by cutting off projecting angles. The animal has to use its fore paws in passing food from its mouth to the pouches, and in emptying the pouches these paws are used very dexterously.

Ginseng.—This drug, which is frequently spoken of as the panacea of eastern Asia, consists of the roots of *Panax ginseng*, belonging to the natural order *Araliaceæ*, a plant indigenous to China and Japan, but chiefly occurring in Corea and Manchuria. The following account is taken from the Lancet: When full grown, the ginseng plant stands from a foot to a foot and a half high, each stem supporting a single palmate leaf. The flower is purple-colored, and in summer is replaced by brilliant red berries. The roots are gathered at the commencement of winter, and, after maceration in cold water for three days, are placed in covered vessels which are suspended over fires until the contents become hard, resinous, and translucent. The drug then appears in the form of brittle rods, often forked or many-tailed, about the thickness of the little finger and from two to four inches in length. The taste is sweetish and glutinous, recalling, in spite of slight bitterness, that of licorice. The wild plant is the most highly valued, but it is extremely rare, being worth more than its weight in gold. According to the Chinese Times, ten large sticks of ginseng and eight of medium size, weighing collectively nine ounces and one fifth, fetched, including duty, seventeen hundred and seven taels (about seventeen hundred dollars). Ginseng culture in Corea is exclusively in the hands of a few state farmers, and is most carefully supervised. The fields are surrounded by lofty barriers, while in each a watchman, perched on a platform, keeps guard night and day. The seeds are set in ridges, the tender shoots being protected from sun or storm by sheds of thatch or coarse cloth. During the first year or two the seedlings are frequently transplanted. They do not attain to maturity until about the fifth year, and, as a rule, are not culled before the sixth or seventh. The leaves are said to possess emetic and expectorant properties, but the roots alone are employed medicinally, being prescribed as a tonic in every disease that is attended by debility. It is as an aphrodisiac, however, that ginseng is in greatest request throughout the whole of the Orient. It is taken in the form of an extract or decoction, the latter mode being generally preferred. It is usually taken in the morning and at bedtime. From three to five grammes of the root constitute a daily dose, and the exhibition may be continued for a week or more. Several unsuccessful attempts have been made to introduce the drug into Europe.

Pilgrims of the Japanese Alps.—In exploring what are called the Japanese Alps, the Rev. Walter Weston found himself in a region still unaffected by European innovations; a plateau more than a hundred and twenty miles long, surrounded by mountain ridges, and known, on account of its se-

cluded position, as "the island province." The old superstitions prevail there in full force: "Hunters burn candles and pray to the spirit of the crag they are climbing"; a black dog or white paper is a charm against the evil one; and "the drawing of 'a horse rampant' is a recognized prophylactic against smallpox." Until a few years ago women were not allowed to climb beyond a certain limit; and when the wife of one of the mountaineers ventured beyond it she was turned, they say, into a stone. Mr. Weston had the very pillar pointed out to him. But the charm is now broken, and women can climb in security. It is, however, considered sacrilegious to climb a mountain till proper parties have been sent to the top to pray the gods for good weather. The mountains are ten thousand or more feet high, of various geological character, and, being near the sea, command peculiar views. Hodekadaka is granite; Yarigstake, the highest peak after Fujisan, is of brecciated porphyry; and Fujisan, nearly two thousand feet higher than the others, is a crater. No railroad or common road enters the mountain region, though both come near it. Mr. Weston met several "pilgrim clubs"—a sort of Alpine clubs having a more numerous membership and costing less than those of the West. "Every year, before the season commences, they meet and decide by ballot who shall climb the sacred mountains. . . . They also stamp their alpenstocks with the names of the mountains they have ascended." They regard their exercise as a religious one, and as they went up they chanted, "May our six senses be pure, and may the weather on the honorable peak be fine!"

The Longevity of Astronomers.—We take the following from an article under the above title in The Observatory. The longevity of astronomers has often been called attention to. The Herschels, the Cassinis, and others have been notable examples. This is all the more curious, as their vocation necessitates late hours and constant exposure to night air. The following consists, says the writer of the paper, of a portion of a list of the names of well-known men connected with astronomy who have lived beyond the allotted human span of "threescore years and ten." The ages are correct to within a few months:

	Obit.	*Age.*
Fontenelle, Bernard de	1757	100
Herschel, Caroline L.	1848	98
Cassini, Count J. D.	1845	97
Sabine, Sir Edward	1883	94
Mairan, De	1771	93
Somerville, Mary	1872	92
Santini, Giovanni	1877	91
Sharpe, Abraham	1742	91
Long, Dr. Roger	1770	90
Airy, Sir George Biddell	1892	90
Thales	B. C. 550	90
Humboldt, Alexander von	1859	90
Robinson, Rev. T. R.	1882	90
Bouillaud, Ismael	1694	89
Rosenberger, Prof. Otto A.	1890	89
Gautier, Jean Alfred	1881	88
Biot, J. B.	1862	88
Cassini, J. D.	1712	87
Messier, Charles	1817	87
Wallis, J.	1703	87
Brewster, Sir David	1868	86
Halley, Edmund	1749	86
Schwabe, Samuel Heinrich	1875	86
Barlow, Peter	1862	86
Pingre, Alexander Guy	1796	85
Longomontanus	1647	85
Horrebow, P.	1764	85
Whiston, William	1752	85
Pritchard, Rev. Charles	1893	85
Maclear, Sir Thomas	1879	85
Hutton, Dr. Charles	1823	85
Dick, Dr. Thomas	1857	84
Woolhouse, W. S. B.	1893	84
Newton, Sir Isaac	1727	84
Le Monnier, Peter Charles	1799	84
Herschel, Sir F. William	1822	84
Lee, Dr. John	1866	83
Bernouilli, Daniel	1782	82
Troughton, Edward	1835	82
Olbers, Dr. William	1840	82
South, Sir James	1867	82
Le Gendre, Jean	1833	82
Nasmyth, James	1890	82
Eratosthenes	B. C. 195	81
Aristarchus	? B. C. 280	81
Emerson	1882	81
Moestlin, Michael	1631	81
Maurolico	1575	81
Bernouilli, John	1748	81
Kant, Immanuel	1804	80
Lassell, William	1880	80
Piazzi, Joseph	1826	80
Mädler, J. H.	1874	80
De Lisle, Joseph N.	1768	80
Bacon, Roger	1294	80
De La Hire, P.	1718	80

Types of the Unemployed.—Of forty-two men in a German colony for unemployed workingmen, described by Mr. Josiah Flynt in the Atlantic Monthly, mechanics and common laborers were most numerous, while others had

been in various occupations, and even noblemen were represented. A third of them were boys and young men, while the majority were between thirty and fifty years of age. Two had been in the United States—one as a labor agitator, while the other had never gone a day without work here, if he wanted it. Other men were in the colony "because they had been unable to find even a bread-and-water existence." They had sought work, always in the large towns, but leaving aside the smaller places, where the farmers were asking for laborers. Most of the old men had trades, "but were too old to ply them satisfactorily." One had come to trouble through politics, another because he was unfortunate in his family life. One, who had indulged a ruthless passion for cruelty and killing, was distinguished for his devout piety. The men expressed their hostility to the church, the monarchy, the army, and the police. Very few of them were out-and-out disbelievers, but nearly all had their own private religious ideas, and were perfectly sincere in stating them. Politically they were revolutionists, republicans, or socialists. They all thought they knew what ailed the world, and what it needed for its regeneration, but it hardly ever seemed to occur to them that they had any personal responsibility in the reforms suggested. They seemed to consider themselves as something aloof from society, justified in making all manner of criticisms, but not required to look into their own failings and sins. Tramps have this same trait. They will talk for hours at a hang-out campfire about what ought to be done to make the world better, and at times with a clearness of perception and earnestness of argument that are unexcelled; but let a little personal introspection or criticism be suggested, "and a silence comes over them like that of the graveyard."

The Bordeaux Vineyards.—As described by C. L. Marlatt, in a report to our Government on wine-making in France, the vineyards of the Bordeaux district extend along the Gironde and Garonne Rivers, and their products are classed and known according to the situation of the plantations or the nature of the soil. The most famous of these tracts, that of Médoc, extends from Bordeaux to the sea and between the rivers and the Landes. This tongue of land, almost a peninsula, is entirely planted with vines, and for a distance of fifty miles and five or six miles in breadth the land is occupied by vineyards. These are separated into small communes, each of which bears some celebrated or ancient name, as Margaux, Saint-Julien, etc., and produces its distinct and well-known brand of wines. The wines vary also according to the vintages, the qualities being affected by variations of seasons. The wines as they are quoted in the market usually bear the name of some château or other. These châteaux, the fame of some of which has become world-wide, are for the most part simply country seats, in which the proprietor resides from time to time. The term château was formerly applied to old manorial residences, and the antique appearance and baronial style of architecture of some of the houses is still suggestive of this association. Oxen are generally used in the rough work of the cultivation of the vineyards, while the more delicate operations are performed by women, who in their neat dresses present a very picturesque appearance among the vines. Some of the cellars in which the wines are stored are very large, and the long rows of hogsheads in them have an imposing appearance. In them the wine is bottled, and stoppered with an especial cork bearing the name of the château. The best wines are kept here for long periods of time, in order to develop the special qualities, coming only with age, which give them their reputation.

Early Writing Materials.—Quintus Curtius is cited by Dr. Bühler, in his work on Indian-Aryan Philology, as affirming that birch bark was in use among the Hindus for writing at the time of Alexander the Great. Its employment began in the northwest, where the extensive birch forests of the Himalayas afforded abundant material, and gradually spread to the other parts of the peninsula. The oldest examples of it, says Mr. A. A. Macdonnell in The Academy, are twists found in Buddhist topes of Afghanistan and in the Bower MS. of the fifth century A. D. According to the testimony of the ancient canonical Buddhist works, leaves, probably those of the palms, were the

ordinary writing material of the oldest times. The earliest example is the Horiazi palm-leaf Sanskrit MS. of the sixth century A. D., which is preserved in Japan, and of which the Bodleian Library, Oxford, possesses a facsimile. In northern India, where they were written on with ink, palm leaves ceased to be used after the introduction of paper; but in the south, where the writing was scratched in with a stylus, they are still employed. Paper was introduced by the Mohammedans, and has been very extensively used for manuscripts. The oldest Gujerat paper manuscript dates from the beginning of the thirteenth century. Neither varnished boards, such as are used in Burma for manuscripts, have been found in India, nor leather or parchment, which the regulations against impurity of materials would forbid Hindus from using. Copper plates were early and frequently used for inscriptions. They furnish a curious illustration of the narrowness of the limits of invention, in that they practically all imitate the shape either of the palm leaves or of strips of birch bark.

Arid Yucatan.—The second contribution by Dr. C. F. Millspaugh to the Field Columbian Museum, on the Coastal and Plain Flora of Yucatan, relates to a region peculiar in its biological character, and differing essentially from the surrounding regions, especially in its flora. There all plants have a desiccated appearance, due to their struggle against drought, while in the neighboring areas—Honduras, Guatemala, Chiapas, and Tabasco—the wealth of exuberant vegetation is marked. The difference is brought about partly by orographic features—the other regions having elements of mountain and ridge and large streams of which the Yucatan region is destitute, and its soil and coralline substratum being so porous that whatever rain falls quickly filters into cavities, caverns, and faults beneath the surface. Hence the only residual supply of water available for vegetation is held in the peculiar *sartenejas*, *aguadas*, and *cenotes*. The sartenejas are depressions in the plain, from a few ounces to several hogsheads in capacity, at the bottom of which sufficient marshy soil has been formed to retain such water as falls into them. These soon dry up after the rainy season and their vegetation lies dormant. The aguadas are simply larger sartenejas, usually of circular outline and from fifty to one hundred feet in diameter. They retain stagnant water and maintain a growth of mud plants throughout the year. The cenotes are deep, perpendicular-walled, nearly circular wells, penetrating the floor of the plain and opening into an abundant supply of clear, cool water, saturated with carbonate of lime. They are from a few feet to a hundred yards or more in diameter, and from thirty to two hundred feet deep to the water level, and prove by their frequency and extent that this great plain is as freely watered far below its surface as most countries are above. Mr. Millspaugh's list of plants collected in this region and its islands includes 418 genera and 734 species.

Owl Trees.—It is common knowledge or common supposition that owls nest in the hollows of trees; and since sentiment is turning to regard these birds as beneficial enemies of vermin rather than noxious destroyers of useful things, talk is occasionally heard of protecting and encouraging them —as Sir Montstuart Grant Duff has done. An English writer has been investigating their nesting places, and finds that they prefer pollard elms in which repeated cuttings have caused growths of gnarls and protuberances and all sorts of shapeless hiding places. In one of these trees become a habitation of birds he found the center of the crown forming a kind of platform walled round by the ruins of what should have been branches. The floor of the platform was constituted of rotten wood, leaf mold, and dead sticks, mixed with the bones and fur of "finely pulverized mice." "The bases of the branches, or what should have been branches, were hollow shells, often measuring yards across, with various holes, bulges, knots, and cracks, some piercing the sides, some making only side chambers and shelves. These caverns are the chosen home of the white owl. In one she sleeps, in another she lays her eggs, in a third she has her larder when the young owls are growing up. In another similar tree, if one be near, her husband sleeps by day; and from any one of the doors or windows she slips out and flies noiselessly across the meadow when an intruder scrambles into

the crown of the old tree. There is such a labyrinth of passages in the hollow chambers that to find the nest is not easy, even when the place of the bird's exit is marked." The testimony to the service rendered by the owls during the vole plague, given before a parliamentary commission of inquiry, is declared to be sufficient to justify complete protection of them by law.

Chess Players' Vision.—The study of the psychology of the great chess players has given Prof. Alfred Binet opportunity to describe a special form of visual memory which he calls *geometrical*. As represented by the players, the elements of blindfold chess playing are reducible to the three principles of erudition, memory, and imagination. By imagination, corresponding to what psychologists call visualization, they represent to themselves as if they saw them the positions of the pieces on the board. It is not an uncommon faculty, but is developed to a rarely high degree in the chess player; and has the peculiar power of abstracting from the object visualized solely the qualities necessary for the combinations of the game, consisting of the reciprocal positions of the pieces and their motions. The image seen by the player is therefore an image of fixed positions and possible movements; or, a geometrical visual image. A second element of blindfold chess playing is the recapitulating memory, or the faculty of repeating all the movements in the order in which they have been played. Blindfold playing rests chiefly on the exercise of these two memories—the memory of position and the memory of recapitulation. The third element of the play, erudition, comprehends the recent memory of a game. The analysis of it furnishes a good occasion for studying the true character of what may be called the memory of ideas, and the part which former recollections play in the acquisition of new conceptions.

MINOR PARAGRAPHS.

EXPERIMENTS on the influence of music upon respiration recorded by MM. Alfred Binet and J. Courtier in the *Année Psychologique* for 1897 indicate that musical sounds, chords, and music in general as a sensorial excitation, independent of all suggested feelings, provoke acceleration of respiration, increasing as the movement is more lively, without disturbing the regularity of the breathing or augmenting its amplitude. The major mode is more exciting than the minor. The heart is similarly affected. The distinction between sad or solemn and lively music appears to be for the most part wholly theoretical, and hardly squares with the complexity of the musical emotions produced by the melodies with the infinite shadings suggested by the ideas of the libretto. The authors, however, infer from their researches that the acceleration of the heart and of respiration was not so marked during the hearing of sad pieces as in those in which joy and high excitation of musical emotions prevail.

A NOVEL use is proposed for the pith of cornstalks as a packing between the inner and outer shell of war vessels. When pierced with a projectile it will absorb water and swell so rapidly as to close the opening before the vessel has leaked to a dangerous extent. This quality is under investigation by official commissions of some of the European nations. The by-product of the process of preparation seems to be equally valuable. The outer rim of the stalk ground up is found to make a fine and palatable food for cattle and horses. It is said to compare favorably too with the corn blades, timothy hay, and wheat bran. It also keeps well, and can be uniformly mixed with any ground grain.

MARKED preferences for different kinds and altitudes of perching places are shown by different birds. The domesticated pigeon perches almost exclusively on buildings; in fact, the seldom flying domestic fowl takes oftener to trees. Wild pigeons, of course, must needs perch in trees. The Spectator calls attention to the fact that some species are never satisfied unless they occupy the absolutely highest point in the neighborhood. Thus, while the jackdaw will sit on any part from the buttresses to the vane of a cathedral, the stork, the gull, the cormorant, and the falcon always seem uneasy unless perched upon the summit of the build-

ing or crag which they choose for a resting place. The Rev. A. Morres writes to The Field giving some observations on the falcons that for many years have made Salisbury spire their haunt. The first year that he saw them one of four peregrines settled on the weathercock, four hundred feet high. On crags and cliffs along the coast seafowl always occupy the highest points. One evening in the autumn of 1893 a cormorant, probably driven inland by a storm, alighted on the arrow of the weathercock on the summit of the parish church spire in Newark-on-Trent, where it remained until morning. For nearly eight weeks it returned each night to its perch upon the arrow, finally disappearing in a November gale. In India the adjutant storks always prefer to stand on the topmost pinnacles of high buildings. Once, when a brick had been left on the highest part of the roof of a house during some repairs, an adjutant was seen to take his stand upon the brick, thus gaining an extra two inches of altitude.

NOTES.

The second session of the Monsalvat School of Comparative Religion (Lewis G. Janes, Director) is to be held at Greenacre, Eliot, Maine, August 3d to September 2d. The purpose of this school is entirely unsectarian, and is described to be to afford opportunity for the scientific study of various forms of philosophical and religious thought under competent teachers. The lectures include courses on the History and Philosophy of Religion and on Christian Origins, by the director; the Vedantic Philosophy and the Religions of India, by the Swâmi Saradânanda, of India; Buddhism, by the Anagârikâ H. Dharmapâla, of Ceylon; The Philosophy and Religion of the Jains, by Mr. Virchaud R. Gandhi, of Bombay; Zoroaster and the Religion of the Parsis, by Mr. Jehanghier D. Cola, of Bombay; and The Religions of China, by the Rev. F. H. James, missionary. A conference for the comparative study of religions will be held during the last week of the school, at which Rabbi Hirsch, of Chicago, Mr. Gandhi, Edward B. Rawson, of New York, and Mrs. Annie Besant will speak on special subjects.

The Newcastle Daily Chronicle of December 17, 1896, speaking of the trial trip of the torpedo boat Turbinia, built by the Marine Steam Turbine Company, Limited, for the purpose of testing the steam turbine engine of Hon. Charles Parsons, says: "Several most successful runs were made, and the very high speed of 29·6 knots was attained over the measured mile. It is believed that this is a speed greatly in excess of anything that has ever been previously accomplished by a vessel of the small dimensions of the Turbinia, which is only one hundred feet in length, nine feet in beam, and has but forty-two tons displacement when fully loaded." As this was only a trial trip, a still higher speed is anticipated after repeated experiments.

It is stated in Nature that M. Camille Flammarion has recently compiled some meteorological statistics regarding the amount of rainfall in Paris, which disclose the remarkable fact that there has been a gradual increase in the fall for the last two hundred years. The following brief table speaks for itself:

	Mm.
1689 to 1719	485·7
1720 to 1754	409·4
1773 to 1797	492·5
1804 to 1824	503·7
1825 to 1844	507·5
1845 to 1872	532·4
1873 to 1896	557·4

Whether this increase is actually due to more rain or to some such causes as better positions for rain gauges, or more improved gauges themselves, one can not with certainty say, but the amount of increase seems rather to negative this. It would be interesting to have similar data from other Continental cities.

The account of the Proceedings of the National Science Club, at its second annual meeting in January, 1896, is late in reaching us, but it loses none of its interest for all that. The purpose of the club is to promote the co-operation of the scientifically inclined women of the country in research and investigation. Twenty papers were read at the annual meeting by members of the club; meetings were held at the reading rooms, 1425 New York Avenue, Washington, several days each week till May; and an experimental course of lectures was given with much success. All parts of the country are represented in the list of nearly a hundred and fifty members, and Norway and Spain furnish corresponding members. The club has twenty-two sections, five of which are in botany.

In a paper read in the British Association, Mr. W. H. Preece mentioned electrical disturbances in submarine cables which produce mutilation of signals and loss of speed in telegraph working, indistinctness of speech and the presence of extraneous and disturbing sounds in telephones, with reduction of the distance through which speech is practicable, which, he said, were due to electrostatic and electro-magnetic induction and to leakage. The paper explained how these disturbances were detected, measured, and mitigated, defined the conditions that determine the distance through which telephony

is possible, and described a new form of cable with which the author proposed to connect England and Germany. With such a cable across the Atlantic, he claimed, treble or quadruple the number of words per hour now practicable might be transmitted with the same weight of material.

Dr. C. Le Neve Foster, her Majesty's Inspector of Mines, while visiting the Snaefell lead mine, Isle of Man, after a recent disastrous explosion there, was, by a series of accidents, exposed to poisoning by carbonic-oxide gas for about two hours, until he was taken out on the verge of death. There were several of the party who had to be taken up one at a time, and he was the last to go. For an hour and a half he recorded notes of his feelings while sinking under the influence of the poison, the last entry giving the time he reached the top. Happily, he recovered. "The world," says Nature, "could ill spare a man with such sterling qualities, and science would grieve to lose an investigator who devoted what seemed to be his last moments to extending knowledge for the 'benefit of others.'" Such heroism would have won immortal fame for a military man.

Prof. Bessey, in the American Naturalist, criticises some recent botanical publications for employing English units of measurements, and urges botanical writers to insist upon the use of metric measures throughout. This would all be very well, but that there are some clear-headed people who insist that our system should not be superseded by any but the best, and who still believe that the metric system has not yet proved itself to be that. If it is really the best, it will work its way without special urging.

Mr. E. P. Martin, of the Iron and Steel Institute, observed at its annual spring meeting, 1897, that American steel makers excel enormously those of Great Britain in the output they obtain from their appliances. They have thus, in spite of the high wages that prevail in America, by working in this wholesale manner brought the cost of production to a very low ebb, so that it is now a question not how much steel British producers should send to America, but how far they can meet American competition within their own boundaries.

Sir Augustus W. Franks, President of the English Society of Antiquaries, who died in May, in his seventy-second year, early developed a taste for mediæval archæology, on which he was a leading authority; became an assistant in the British Museum in 1851, and afterward Keeper of the Department of British and Mediæval Antiquities and of Ethnography, and was subsequently till his death a member of the Standing Committee. His principal discovery in archæology was to distinguish the period of "late Celtic" antiquities. Among his archæological works are Ornamental Glazing Quarries, Medallic Illustrations of British History, and an edition of Kemble's Horæ Ferales, which his additions converted, Nature says, into a standard work.

Mr. A. D. Bartlett, Superintendent of the London Zoölogical Gardens, whose death has recently been announced, was originally a hairdresser, and incidentally a bird fancier, specially knowing in canary birds. He obtained a position in connection with the animals at the Crystal Palace, and afterward at Regent's Park. He acquired a remarkable acquaintance with animal life, its habits and diet, and was a skillful appraiser of the value of specimens. With all these accomplishments in zoölogy he was not a writer.

Mr. Edward James Stone, for the past twenty years Director of the Radcliffe Observatory, died in Oxford, England, May 9th, aged sixty-six years. Previous to assuming charge of Radcliffe Observatory he had been her Majesty's Astronomer at the Cape of Good Hope. His special field was the "astronomy of position," and his reputation was mainly won by devotion to meridian observations. He studied the constants of nutation and refraction, the proper motions of the stars, the systematic differences between stellar catalogues, the motion of the solar system in space, and the sun's parallax; and contributed much to the organization of the various astronomical expeditions to the southern hemisphere. He had been President of the Royal Astronomical Society, and held other relations to several learned bodies.

The death is announced at Gothenburg, Sweden, of Baron Oscar Dickson, the wealthy merchant who helped equip Nordenskiöld's first (1868) and bore the entire expense of his second arctic expedition (1872–'73). Baron Dickson was also a large contributor to the expeditions of 1875, 1876, and 1877.

Matthew Carey Lea, who died in Philadelphia on March 15th, devoted himself especially to the study of the chemistry of photography, and particularly to the action of light, etc., on the salts of silver, and published in 1887 a paper on the Identity of the Photo-salts of Silver with the Material of the Latent Photographic Image. He discovered and described three allotropic states of silver. He was a frequent contributor on this and related subjects to the American Journal of Science, had published fifty-four "more important" papers when elected to the National Academy of Sciences in 1892, and issued in 1868 a Manual of Photography, which reached a second edition in 1871.

The deaths are announced abroad of Julius von Sachs, the distinguished botanical author, and of the veteran chemist, Fresenius.